DETAILED ADMINISTRATION REPORTS OF SUBORDINATE OFFICERS OF THE DEPARTMENT OF AGRICULTURE MADRAS

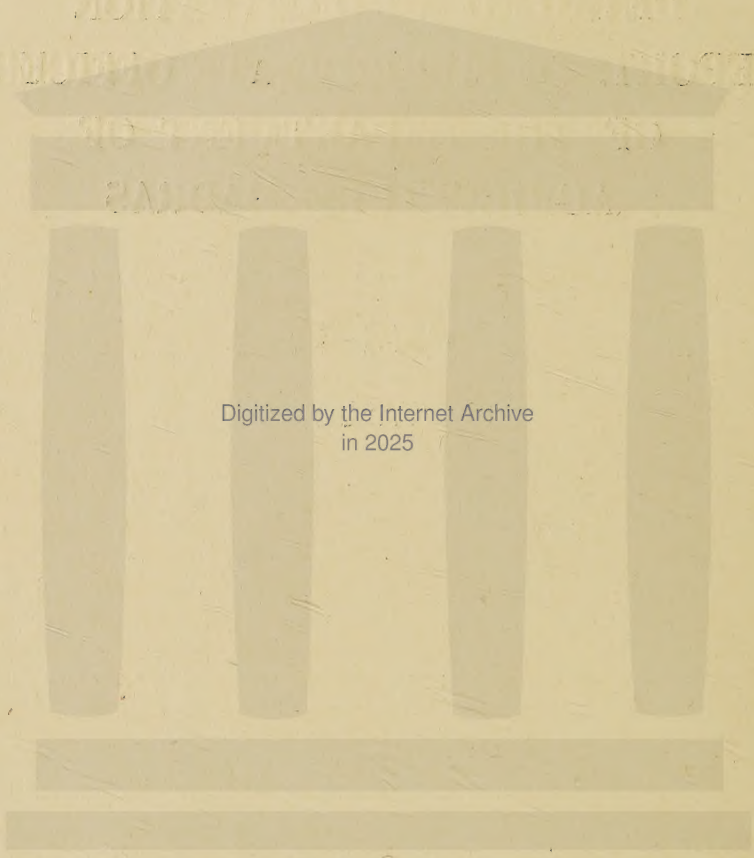
FOR

1943–44

(FASLI)

PRINTED BY THE SUPERINTENDENT
GOVERNMENT PRESS
MADRAS
1950

COMMONWEALTH MYCOLOGICAL INSTITUTE
17 DEC 1953



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DETAILED ADMINISTRATION REPORTS OF SUBORDINATE OFFICERS OF THE DEPARTMENT OF AGRICULTURE, MADRAS, FOR 1943-44 (FASLI).

DETAILED ADMINISTRATION REPORT OF THE GOVERNMENT AGRICULTURAL CHEMIST FOR THE YEAR 1943-44 (FASLI).

I submit herewith the detailed report of the working of the Government Agricultural Chemist's section during the fasli year 1943-44.

I took charge of the section on the forenoon of 19th August 1943 from Mr. P. V. Ramiah on the appointment of the latter as wholetime Principal of the Agricultural College. Sri T. S. Ramasubramania Ayyar, Assistant Agricultural Chemist retired from service on 9th September 1943 and Sri M. Suryanarayana, officiating Assistant Agricultural Chemist, died on 21st December 1943. In these officers the section has lost two experienced and talented workers. Sri C. V. Ramaswami Ayyar, Assistant Agricultural Chemist, was appointed to the newly created post of Superintendent, Government Malt Factory, in the Madras Agricultural Service, and took up his duties on 10th January 1944, forenoon. In the Subordinate Service, Dr. R. Kochukrishna Pillai was relieved on 26th November 1943 to take up an appointment under the Board of Scientific and Industrial Research at New Delhi. Sri G. K. Chidambaram, Sri S. Varadarajan and Sri P. Kunhi Raman Menon left the section on 1st April 1944, 26th March 1944 and 29th April 1944, respectively, to join their temporary posts of Analytical Chemists in the Food Department. The loss of so many experienced hands during such a short period, has considerably hampered the working of the section.

The work of the section is, as usual, reported under three major heads :—(i) General including Analytical and Advisory work, (ii) Teaching and (iii) Research on problems of Soil Science, manuring, plant and animal nutrition, Microbiology, and Agricultural Industries.

I. General.

Weather.—The usual meteorological observations were taken daily at 8·00 hours local time at the observatory attached to the Research Institute. The figures were not published owing to wartime restrictions. The table below gives a summary of the records maintained at the institute for the period April 1943 to March 1944.

TABLE I.—*Meteorological data for* 1943-44.

Year and month.	Temperature of						Relative humidity per cent.			Rainfall in inches.				Wind (miles per hour).		
	Absolute maximum.	Absolute minimum.	Mean maximum.	Departure from normal.	Mean minimum.	Departure from normal.	At 8 a.m.	Mean for the month.	Departure from normal.	Actual for the month.	Mean for the month.	Departure from normal.	Number of rainy days.	Actual for the month.	Mean.	Departure from normal.
1943—																
April	99·8	67·7	94·7	— 0·9	72.1	— 1·0	70·9	71·1	— 0·2	2·12	1·88	— 0·24	4	1·2	2·6	— 1·4
May	99·6	68·2	91·7	— 3·3	71·4	— 2·6	71·2	70·2	+ 1·0	1·55	2·60	— 1·05	5	2·2	3·7	— 1·5
June	91·2	69·7	87·1	— 1·9	72·2	— 0·9	67·6	69·5	— 1·9	0·66	1·48	— 0·82	1	4·2	7·4	— 3·2
July..	90·3	69·7	85·4	— 1·1	72·3	Nil.	70·3	71·9	— 1·6	2·03	2·08	— 0·05	3	5·5	8·6	— 3·1
August	91·3	66·7	88·5	+ 1·6	70·6	— 0·5	72·9	74·0	— 1·1	0·51	1·19	— 0·68	3	2·8	7·0	— 4·2
September	91·7	67·2	88·6	— 0·9	70·5	Nil.	69·6	73·5	— 3·9	0·61	1·79	— 1·18	2	3·7	5·3	— 1·6
October	90·0	66·0	85·4	— 2·1	70·2	— 0·2	86·3	79·9	+ 6·4	9·30	5·70	+ 3·60	18	1·0	2·8	— 1·8
November	88·3	63·2	85·5	+ 1·0	69·0	+ 0·5	80·5	80·6	— 0·1	3·85	4·80	— 0·95	4	0·9	2·2	— 1·3
December	86·9	60·2	84·0	+ 0·2	65·8	+ 0·7	77·0	78·8	— 1·8	0·04	1·49	— 1·45	Nil.	1·5	3·0	— 1·5
1944—																
January	92·0	56·7	85·9	Nil.	65·1	+ 0·9	75·8	76·2	— 0·4	0·43	0.70	— 0·27	1	1·0	3·0	— 2·0
February	92·2	62·6	89·7	— 0·3	68·0	+ 2·2	74·8	71·9	+ 2·9	0·45	0·52	— 0·07	1	0·6	2·8	— 2·2
March	96·2	64·0	92·0	— 2·8	70·6	+ 0·9	73·3	69.7	+ 3·6	0·70	0·81	— 0.11	2	0·7	2·7	— 2·0
									Total ..	22·25	25·04	— 2·79	44			

The total rainfall during the year fell below the average by 2·79 inches, the deficit being shared by both the south-west and north-east monsoons. The month of September was particularly droughty with the result that the standing crop of paddy threatened to be a complete failure. The heavy rainfall received in October helped its recovery, though the yields were on the whole below normal.

Analytical and advisory.—This branch of the section was, as usual, engaged in the analysis of samples of soils, manures, irrigation, water, foodstuffs, fodders, sugarcane, dairy products and miscellaneous samples connected with Agriculture, advice being given to the parties concerned wherever called for. Part of this work was connected with the research activities of the section, the rest having been undertaken on requisition from officers of the Agricultural and other Government departments, from ryots and landholders, and in some cases from industrial concerns. Besides analytical work as detailed above, numerous enquiries from different sources relating to the activities of the section were received and answered from time to time.

Two thousand seven hundred and seventy-four samples were received and registered during the year, as against 1,845 during the previous year. The number analysed and reported on totalled 2,292, classified as below according to nature of samples and sources of receipt.

TABLE II.

Nature of samples.	Research.	Agricultural department.	Other Government departments.	Ryots and private parties.	Total.
Soils	16	63	77	7	163
Manures and compost ..	2	70	16	72	160
Foods and fodder	269	126	53	1	449
Water	..	37	1,000	2	1,039
Oil seeds and fats	..	5	1	..	6
Milk and other dairy produce.	..	34	..	..	34
Sugarcane and jaggery ..	2	373	..	..	375
Miscellaneous	1	9	54	2	66
Total ..	290	717	1,201	84	2,292

A sum of Rs. 937–8–0 was received during the year as analytical fees from ryots and other private parties.

Of the samples analysed and reported on, the following may be mentioned as of special interest :—

(1) The analysis of water samples periodically collected at different points in the Mettur reservoir was continued throughout the year at the instance of the Executive Engineer, Salem. Nine

hundred and ninety-nine samples were examined for dissolved and suspended solids for collecting data on silt accumulation. The work is expected to be continued for a total period of five years.

(2) The periodical analysis of water samples from the Pennar River at the site of proposed reservoir near Gandikota in Cuddapah district was concluded and a report embodying the results of analysis of 16 samples submitted. The figures show that the water contains less than 60 parts of dissolved salts per 100,000, though a good percentage of the latter are those of sodium, chiefly to bicarbonate and chloride. It may, however, be used for irrigating dry crops with the necessary precautions. The growing and ploughing in of green manure and the cultivation of swamp paddy once in three or four years have been suggested as measures likely to reduce salt accumulations in black soils irrigated with this water. It has been proposed to carry out one more round of analysis of flood water during the current year, as suggested by the Chief Engineer for Irrigation.

(3) In connexion with the Sabari irrigation project in Bhadrachalam taluk, East Godavari, a sample of water from the Sabari river was analysed for its salt content. The sample contained 38 parts of total solids per 100,000 and has been recommended as fit for irrigating all crops.

(4) Forty-nine samples of earth from existing tank bunds or intended for proposed tank bunds were tested for the Public Works (Irrigation) department, in regard to their suitability for the formation of bunds. The tests were based on the fact that soils containing a good proportion of clay and are alkaline (sodium clays) as indicated by a high p^H and the presence of sodium carbonate and bicarbonate do not allow water to percolate through and are therefore suitable for forming bunds of reservoirs. Eighty-four samples from similar sources are under examination.

(5) A sample of soil and one of water from an unproductive area in the village of Cheemala Vagupalle (Anantapur district) were received from the Agricultural Demonstrator, Tadpatri. The water sample contained 175 parts of salts per 100,000, of which nearly 140 parts were those of sodium. Irrigation with such water was bound to lead to alkalinity in any soil. The soil was a clay loam containing 0·14 per cent of soluble salts, which were exclusively those of sodium. It had a p^H of 9·03. Alkalinity had evidently developed as a result of irrigation with water containing a high percentage of sodium salts. Though complete reclamation was, not possible, ameliorative measures such as bunding of plots with periodical flooding, the utilization of rain water for washing out of the salt accumulations and the application of heavy doses of organic matter were recommended.

(6) Four samples of fish meal prepared from different varieties of fish were analysed for their manurial value at the request of the Special Officer for Fish Industry, Madras.

The results are given below :—

	Fish meal (ribbon fish).	Fish meal (miscel-laneous fish).	Shrimp meal.	Prawn meal.
	PER CENT.	PER CENT.	PER CENT.	PER CENT.
Moisture	8·5	8·6	11·8	10·1
Nitrogen	9·5	8·3	10·9	10 0
Phosphoric acid ..	9·7	5·6	3·2	5·4
Potash	1·1	0·9	1·9	1·6

The percentages of nitrogen and phosphoric acid varied widely with the variety of fish used, shrimp meal and prawn meal containing a high percentage of nitrogen, but relatively low phosphoric acid.

(7) A sample of damaged tea leaves forwarded by Messrs. Sripad Narasimham Bros. *Kakinada*, was analysed for its manurial value with the following results :—

	PER CENT.
Moisture	14·09
Loss on ignition	75·95
Insolubles	0·56
Nitrogen	4·45
Phosphoric acid ($P_2 O_5$) ..	0·80
Potash ($K_2 O$)	2·30

The sample being rich in nitrogen and potash, would be a valuable organic manure.

(8) Samples of calcined bones, prepared by burning bones in paddy husk (as suggested by Mr. M. S. Sivaraman, I.C.S.) were received for analysis from Agricultural Officers in different districts. The phosphoric acid contents of the samples varied with the degree of calcination, as the following analysis of four samples received from the District Agricultural Officer, Nellore, shows :—

	Sample. A	Sample. B	Sample. C	Sample. D
Moisture ..	4·73	5·71	6·22	3·50
Loss on ignition ..	1·55	19·28	8·48	1·74
Insolubles	0·41	1·05	1·12	1·13
Nitrogen	0·11	2·04	0·98	0·14
Phosphoric acid $P_2 O_5$.	37·88	29·72	33·38	37·54

Samples A and D were greyish in colour and well burnt, sample C was dark grey, and sample B was almost black, at the bone char stage.

(9) A sample of sea-weed received from the Agricultural Demonstrator, Ramnad, analysed as below :—

	On air dry basis.	On original moisture basis.
	PER CENT.	PER CENT.
Moisture	11·57	21·02
Loss on ignition ..	59·87	53·48
Nitrogen	1·29	1·15
Insolubles	0·50	0·45
Phosphoric acid $P_2 O_5$ ..	0·45	0·40
Potash $K_2 O$	8·63	7·71

The weed had a high potash content, and would form a useful manure preferably applied as compost.

(10) Two samples of malt food, one prepared by the Scientific and Industrial Works, Coimbatore and the other by the Gudlavalleru Co-operative Society were received for analysis and report. The former was a pinkish coloured powder, with a lintner value and fat content suggestive of cholam malt, but its protein and sugar content were higher. There was also evidence of the addition of milk powder with some colouring matter. The keeping quality of the preparation was found to be very poor. The other sample was darker and coarser than the malt food prepared at the Government Factory, and had a lower diastatic value and carbohydrate content. In other respects it resembled average samples of cholam malt food.

(11) Samples of polished and unpolished grain from five cholam strains A. S. 29, A. S. 3313, A. S. 5414, T. 1 and T. 6, and three cumbu strains P. T. 700, P. T. 367 and P. T. 248 were received from the Millets Specialist for analysis and report on the relative nutritive values of the different strains as well as the loss in nutrition due to polishing. Of the five cholam strains A.S. 129 had the highest nutritive value, followed closely by T. 6, strain T. 1, being comparatively poor. Cumbu strain P. T. 367 was the best in point of nutritive value, containing 33 per cent more of protein than the other two, which were at about the same level. An examination of the results of analysis of the polished and unpolished grain from the different strains of both these millets showed that, while in general the protein content was not seriously affected by polishing, there was distinct loss in soluble ash, fibre, ether extractives and phosphoric acid as a result of polishing.

(12) A sample of residue from the sea-weed Gracilaria Lichenoides after the preparation of agar-agar was analysed for its feeding and manurial values. It contained 18 per cent of protein and 2·2 per cent of lime and would make a valuable cattle feed. It was poor in manurial value.

II. Teaching.

Degree course of the Madras University.—The College re-opened on the 15th June for the second and third year students and on the 2nd July for the fresh admissions to the first-year class. The statement below gives the number of lectures delivered and the practical classes held during 1943-44 :—

Class.		Lecture classes.	Practical classes.
		HOURS.	HOURS.
B.Sc. (Ag.)	I year	62	58
,,	II ,, ...	61	36
,,	III ,, ...	130	90

Short course of the Agricultural College—(*a*) *Malt making.*—A course of lectures on malt and malt making was given to students of the short course in farm management from 1st to 14th of September. Six students took the course. Besides practical work of 5 and 6 hours on each of the working days, a course of four lectures explaining the stages in production of malt were arranged. The course was brought to a close with an oral test. The students were made acquainted with the large scale preparation of malt and malt extracts.

(*b*) *Jaggery making.*—A similar course of lectures on jaggery making was arranged from 7th to 21st February. Seven students took the course. The methods of preparing ordinary and cream jaggery from cane and coconut juices were demonstrated and four lectures were delivered on the composition of the cane. The students were taken on a visit to the Podanur Sugar Factory where full details of manufacture of sugar were explained.

III. Research.

A. Soils.

(1) ***Fundamental studies on the origin and properties of black and red soils of the Madras Presidency.***—This investigation was undertaken with a view to furnish an explanation for the formtaion of black and red soils, with entirely different properties, in contiguous areas from Archaen gnesses and granites. The previous year's report dealt with the examination of the two soil types found in the Coimbatore taluk, which led to the conclusion that, though both the types are derived from Archaen gneisses and granites, the black soil was derived from rocks formed Calcic magma and red soil from alkali magma. The analysis of mechanical separates of type samples collected from the Udumalpet area was continued during the year under report. Determination of exchangeable CaO in two clay fractions and two fine silt fractions from Udumalpet red soil gave the following results :—

		Exchangeable CaO.	Total silicate CaO.
		PER CENT.	PER CENT.
Udumalpet Red soil clay ..	0—12 inches.	0·72	0·71
Do.	33—36 ,,	0·96	1·06
Udumalpet Red Soil Fine Silt	0—12 ,,	0·57	..
Do.	33—36 ,,	0·81	..

It is evident that the CaO content of red soil clay at the surface is almost wholly exchangeable CaO, and even in the lower depths a high percentage of the total lime is exchangeable CaO. The fine silt fraction also has apparently a high exchangeable CaO content. This definitely proves that a high exchangeable CaO content is not necessarily confined to black soils as usually believed.

Chemical analysis of fine sand fractions of black and red soils at different depths in the profiles shows that in both cases the lower layers have more of moisture, loss on ignition and bases presumably due to greater hydration and decomposition at lower depths. In the black soil sand the calcium is present mostly as carbonate. Exchangeable CaO is low. Silicate CaO occurs only in traces at the surface but increases appreciably at the lower depths. It is also poor in soda and potash. In the red soil sands moisture and loss on ignition are greater than in the corresponding fraction of the black soil, the values increasing with depth. The loss on ignition is not due to calcium carbonate as in the the case of black soils. This fact and the presence of more bases, lead to the supposition that there has been a greater amount of decomposition in sandy fraction. This is not usual with red soil sand, but the peculiarity may be due to irrigation it is said to have received which has resulted in greater hydration and decomposition. The fraction from the deeper layers, however, contained much calcium carbonate and a fair amount of magnesia as carbonate. The differences between the values obtained by the fusion and HCl digestion methods of analysis of sand fractions were about the same in black as well as red soils, indicating that the nature of mineral or minerals not attacked by acid were the same in both cases. The sandy fraction of the top layers of both the black and red soils are found to contain comparatively more $R_2 O_3$, soda and potash than the bottom layers. This may be tentatively explained by the supposition that the greater hydration at lower depths brings about greater disintegration and decomposition. the decomposed material giving rise to $CaC O_3$ from CaO and acid soluble $R_2 O_3$, and the alkali being lost in drainage.

Microscopic examination of the sand fractions of the respective soils revealed the presence of much quartz and fair amounts of hornebl'ende, opaque iron minerals and leucoxenes (weathered product of titanite) in the black soil sand, the red sand containing much quartz, leucoxenes in larger quantities than in the black sand, and stray bits of horneblende, zircon and microcline.

Dehydration studies were made on the clay fractions separated from red and black soils by heating them from 100° to 700°C. in stages of 50°C in a muffle furnace. The curves obtained were similar to the dehydration curves of black and red soil clay from other parts of the Presidency. The black soil clay curves resemble those of Scolecite (Ca. Zeolite) and the red soil clay curves those of Kaolin.

Study of rock formations in the Gobichettipalaiyam area.—The geological formations round about Gobichettipalayam are mostly

granites and gneisses, with dykes of amphibolites, quartz and pegmatites. The amphibolite (pyroxenites) dykes are very conspicuous forming small hillocks round about. On account of their association with red soils they are mistaken for hæmatite, but the grey streak and lower specific gravity give a clue to their real composition. The amphibolites have given rise to large beds of Kankar and red soil, and dueir to their association with red soils i, was mistaken for Commingtonites in the field ; but analysis shows that they contain CaO to the extent of 11·6 per cent. Detailed analysis of red soil samples from the amphibolite and micaceous granite areas has thrown some light on the formation of red and black soils. The idea that rocks containing calcium silicates give rise to black soils alone needs to be revised in the light of this finding. In the absence of soda, the calcium bearing silicate minerals (amphibolites), etc., decompose in a neutral or acid medium, leading to the formation of red soils. Where soda is present, the decomposition takes place in alkaline medium giving rise to black soils.

(2) *Investigations on 'Savar' soils.*—The District Agricultural Officer, Trichinopoly, reported the presence of a belt of 'Savar' land extending over a hundred acres, between blocks of wet lands in the Lalgudi taluk, Trichinopoly district. The peculiarity about this belt of land is that the soil should be allowed to dry up till it cracks for about ten days in the Samba season, two to three weeks after transplanting the samba crop, else a very poor corp is obtained. Even after the cracking is allowed, the yield is found to be below that of the adjoining wetlands. Further, the 'Savar' lands do not stand wetting for a long time for the Kuruvai crop as is done elsewhere. Heavy manurial applications did not result in improvement. Soil samples were drawn at the first and second foot depths from the 'Savar' lands as well as the good lands nearby and analysed for pH value, soluble salts, and mechanical composition. There was no appreciable difference in texture between the two soils both containing 35 45 per cent of clay and 12–15 per cent of silt. But the 'Savar' soils have a lower pH (6 to 7) than the good soils (over 8) and a lower salt content (0·03 to 0·04) than the good ones (0·08 to 0·09 per cent) less of calcium being present in the soluble salt of the 'Savar' soils. The exchangeable bases are being estimated and the work is proceeding.

(3) *Reclamation of soils in the Vaippar area, Tinnevelly district.*—This is a flat area of saline waste, the low-lying portions of which being subject to inundations from the sea on one side and the jungle stream on the other. The question has been raised whether this waste could be reclaimed and utilized for soldiers' colonies after the war. The annual rainfall in the area is only 22 inches and fresh water is not available in sufficient quantities for reclamation purposes at present. Profile pits were dug in two of the low-lying areas and one higher up, and soil samples collected at different depths. The water table in the lower portions was at about 4 feet from the surface, and that in the higher land below 5 feet.

The soil of the inundated areas was a sandy loam with 0·14 per cent soluble salts at the surface and more than 10 per cent at lower depths. The sub-soil water was very brakish. Gypsum was found at the lower depths in these two profiles, and at all depths in the profile higher up. Chances of reclamation depend on the availability of fresh water from wells sunk in the river-bed or the sandy area near the coast. Subject to such availability trials may be made after taking preliminary steps to prevent inundations from the sea and river by the erection of suitable embankments and lowering the water table by deep trenching and pumping out of sub-soil water. The whole process is likely to be a costly one.

(4) *Reclamation of alkaline lands under dry conditions.*—As reported before, these experiments were started as an attempt to reclaim certain alkaline blocks of land in the Guntur district with the help of the available rainfall (40 inches a year) of the locality. The eight plots laid out in the village of Peddapalakalur were bunded and treated as follows:—

(*a*) Control, no treatment,

(*b*) bunded, with application of heavy doses of cattle manure (40 tons per acre) and soil mulch,

(*c*) bunded alone, and

(*d*) bunded with soil mulch.

Efficient drainage was provided to remove percolation water from the plots, and a set of soil samples taken and analysed. It is proposed to try a suitable crop this year and analyse another set of soil samples from the different plots.

(5) *Studies on the soils of the Godavari delta.*—Previous work on the soils of the Kistna and Godavari deltas have shown that the soils of the Kistna delta are similar to the black soils (with gypsum) of the Presidency, are clayey and have a high salt content, while those of the Godavari delta are alluvial, freely drained and free from alkaline patches. A more detailed study of the soils of the Godavari delta was taken up during the year. A traverse was made between the Gowthami and Vasishta branches of the river and four profile pits located on the banks of these branches and in the Central delta were examined in detail. Physical and chemical analysis of the profile samples were carried out. Mechanical and chemical composition of samples from a typical profile pit near Gopalapuram on the Vasishta branch of the river are given in the table below:—

TABLE III.—*Results of mechanical analysis.*

Pit No. 1. Gopalapuram. Godavari Delta Soils

Vasishta Branch.

(1)	0–1′ (2)	1–2′ (3)	2–3′ (4)	3–4′ (5)	4–5′ (6)	5–6′ (7)
Moisture	5·1	5·2	5·7	4·2	4·7	7·2
Clay	28·9	32·5	36·8	26·0	25·2	51·9
Silt	21·7	25·3	29·5	15·2	17·8	29·4
Fine sand	47·1	37·8	29·0	54·4	49·9	15·5
Coarse sand ..	1·3	2·5	2·7	2·3	3·9	1·8

Pit No. 2. Palivala. Central Delta.

	0–1′	1–2′	2–3′	
Moisture	7·0	6·8	6·9	
Clay	25·7	26·2	25·1	
Silt	17·6	15·6	21·7	Water table below 3 ft.
Fine sand	49·1	44·0	51·3	
Coarse sand ..	3·7	7·2	1·7	

Pit No. 3. Kedarlanka. Gowthami Branch.

	0–1′	1–2′	2–3′	3–4′	4–5′	5–6′
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Moisture	5·8	4·9	5·2	6·2	5·6	5·4
Clay	25·2	28·6	18·6	19·9	24·4	21·7
Silt	24·3	16·4	26·4	31·1	42·6	46·4
Fine sand	43·5	46·7	48·5	40·2	26·5	26·2
Coarse sand ..	3·4	5·9	2·8	4·6	4·6	4·1

Results of chemical analysis.

Pit No. 1. Gopalapuram. Godavari Delta.

Vasishta Branch.

Heads of analysis.	0–1′	1–2′	2–3′	3–4′	4–5′	5–6′
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Moisture	5·1	5·2	5·7	4·2	4·7	7·2
Loss on ignition ..	1·79	2·34	3·14	1·41	2·02	3·81
Insolubles	79·18	78·89	80·74	83·45	82·21	76·37
Iron and alumina (Fe_2O_3 and Al_2O_3).	11·33	12·95	8·79	10·91	9·86	7·36
Lime (Ca. O) ..	3·79	3·34	2·25	4·59	1·36	2·91
Phosphoric acid ($P._2O_5$).	0·056	0·062	0·059	0·067	0·063	0·067
Nitrogen (N) ..	0·036	0·041	0·031	0·044	0·032	0·035

The analysis of samples from the pits near the two branches showed that, in general layers of sand alternate with layers rich in silt and clay. Samples from the pits near the Vasishta branch are richer in fine fractions (silt and clay) than those near the Gowthami branch. It was observed that soils near the Gowthami branch are more fertile than those near the Vasishta branch. As a result of chemical analysis and alkalinity determinations in samples from the pit near the Vasishta branch it was found that the total salt content of the soils in the deltaic area is generally low and that the top 4 feet are on the whole rich in lime and nitrogen.

(6) *Dry-farming experiments.*—The headquarters of the Soil Physicist continued to be at the Dry Farming Station, Hagari, till February 1944, when it was transferred to the Agricultural Research Institute, Coimbatore. The work done by the Soil Physics Branch during the year is summarized in the following paragraph :—

(1) *Soil moisture work.*—In order to study the effect of inversion ploughing on soil moisture, studies on the field distribution of moisture were made in plots which received different types of ploughing as preparatory tillage, at Hagari. The following are the variants :—

(i) Control—working guntaka or the blade harrow three times as preparatory tillage.

(ii) Light non-inversion ploughing by the country plough.

(iii) Light inversion ploughing by P. S. G. plough No. 16-B.

(iv) Deep inversion ploughing by Cooper No. 21.

Soil moisture was studied periodically by using the same technique that was adopted in former years for soil sampling, viz., using a King's tube sampler. Six to eight individual samples were used for arriving at the average moisture figure for any treatment in each of the layers 0—6 inches, 6—12 inches and 12—24 inches. The results of moisture determinations for the different dates of sampling are given in the following table :—

Moisture per cent on dry basis for the layers of soil 0—24 *inches.*

	20th September 1943.	18th October 1943.	20th November 1943.	16th December 1943.	24th January 1944.
(1)	(2)	(3)	(4)	(5)	(6)
A. Control	19·8	20·5	19·5	19·4	15·4
B. Country ploughing.	20·5	21·5	22·7	20·3	15·8
C. Light inversion ploughing.	20·9	22·0	21·7	20·2	15·8
D. Deep inversion ploughing.	18·1	21·9	21·7	19·8	14·9
Rainfall between the dates in inches.	4·05	2·88	0·90	..	..

The difference between the various treatments are not significant. It is clear that the plots which received deep ploughing did not show any particular advantage over the rest in point of moisture conservation. The same result was obtained during the previous season when the deep ploughed plots showed the lowest amount of moisture. The plots which received country ploughing and light inversion ploughing usually contain about the same amount of moisture, which is slightly higher than the control (unploughed).

In another set of plots the effect of bunding on soil moisture was studied. Bunding as usual has shown its superiority over the control (unbunded).

(2) *Studies on surface run-off.*—In the two run-off plots set up at Hagari during 1937–38 studies on surface run-off were continued during the rainy season of 1943–44. One plot continued to be clean fallow from 1937–38 while the other plot was cropped with setaria during September 1943. Run-off data obtained by the measurement of soil and water losses after rains is given below :—

Data on surface run-off from 31st August 1943 to 22nd November 1943.

	Fallow plot.	For some time cropped.
1 Number to days when there was run-off..	8	8
2 Total rainfall on days when there was run-off.	6·2″	6·2″
3 Rain water lost in inches	0·97	0·86
4 Rain water lost expressed as per cent of rainfall received.	15·63	13·85
5 Silt washed off in tons per acre	0·474	0·782
6 Silt washed off in tons per acre per inch of rain water lost.	0·493	0·918

The data is exclusive of run-off on 29th September 1943, when both the cisterns overflowed due to a rainfall of 2·19 inches.

Run-off recorded in the above plots is not considerable. There has been a steady decline in the amount of run-off taking place from the fallow plot during the last four years as shown below, indicating that under undisturbed conditions run-off losses tend to reduce.

Years.	Fallow plot.	
	Total rainfall on days of run-off.	Per cent of rain water lost by surface run-off.
1940–41	7·63	36·33
1941–42	11·40	23·16
1942–43	6·44	19·93
1943–44	6·20	15·63

The soil loss from the cropped was slightly higher than that from the fallow plot due to the disturbance that the plot received during the sowing and the harvest of the crop of setaria.

(3) *Studies on soil tilth.*—In order to arrive at a quantitative measure of soil tilth sieving tests were conducted on soil samples taken from plots under ploughing trials at Hagari. Sieves of square mesh of sides 1·5″, 0·5″ 0·25″, and 0·10″ were used. A uniform period of one minute was allowed for the sieving of each fraction. The percentage by weight of each fraction was determined. The

following table gives the total surface area in 100 gms. of air dry soil assuming that the particles which pass through the sieve are cubes with sides intermediate between the sieve through which they pass and the sieve on which they are held. The figures given in the table are actually proportional to the real area of surface.

Inversion versus non-inversion ploughing experiments (Hagari)— Total surface area of aggregate particles.

Date of sampling.	Control.	Country ploughing.	Light inversion ploughing.	Deep inversion ploughing.	Rainfall between the dates.
					INCHES.
30th July 1943	1,575	1,624	1,667	1,552	..
19th September 1943 ..	1,628	1,686	1,783	1,599	2·95
15th October 1943 ..	1,542	1,684	1,601	1,523	4·35
20th November 1943 ..	1,492	1,263	1,466	1,387	2·88
16th December 1943 ..	1,414	1,225	1,352	1,276	0·90
24th January 1944 ..	1,644	1,574	1,643	1,406	Nil.

Deep ploughing usually resulted in a low figure for surface area due to the presence of a larger proportion of the bigger aggregates. During the dry period 16th December 1943 to 24th January 1944 there has been a conspicuous increase in the total surface area of the particles indicating the crumbling down of the larger aggregates and the formation of finer material due to withering.

Similar studies were conducted from March 1944 in the red and black soils of the Cotton Breeding Station, Coimbatore, when the plots received the different types of cultivation detailed below :—

Red soils treatment.	Black soils treatment.
A. No ploughing	A. No ploughing.
B. Country ploughing twice.	B. Country ploughing twice.
C. Country ploughing four times.	C. Country ploughing four times.
D. Do. six times.	D. Do. six times.
E. Do. eight times.	E. Do. eight times.
F. Cooper 26, once.	F. Cooper 26, once.
G. Do. twice.	G. Do. twice.
H. Guntaka once.	H. Guntaka twice.
J. Do. twice.	J. Standard (Victory plough once and Country plough once).
K. Standard (Victory plough once and country plough once).	K. Do.

The red soils generally gave a larger surface area than the black soils because of the case with which the coarser aggregates crumble down into finer material in the former. In the red soils the plots that received deep cultivation generally gave a higher value for total surface area than the rest of the plots. The

progress of withering during the dry season may be seen in the values for surface area on 23rd March 1944 and 14th April 1944 given below :—

Total surface area (red soils)

Treatment.	23rd March 1944.	14th April 1944.
A. No ploughing	1382	1561
B. Country ploughing twice	1510	1459
C. Do. four times ..	1240	1491
D. Do. six ,, ..	1374	1475
E. Do. eight ,, ..	1309	1687
F. Cooper 26 once	1633	1711
G. Cooper twice	1408	1505
H. Guntaka once	1436	1387
J. Guntaka twice	1493	1628
K. Standard (Victory plough once and country plough once)	1646	1682

While it is the finer fractions that contribute most to increasing the surface area, it has yet to be determined as to which of the individual fractions determines most the field behaviour of soils. This point is under investigation.

Dispersion co-efficient.—As a measure of the stability of aggregates in water dispersion the amount of clay remaining in suspension after the soil is dispersed in water for a definite time was also measured for sample taken from plots under the cultural experiments detailed above.

B. Manures and manuring.

1. *Field experiments, Central Farm, Coimbatore*—(i) *Old permanent manurials.*—Fodder cholam was grown in the plots under rainfed conditions as facilities for irrigation were not available. Manuring and sowing were done on the 5th and 6th October 1943, respectively, after a sharp shower of rain. The crop was harvested on 5th January 1944. The yields of dry fodder from the different plots are tabulated below :—

Old permanent manurials.—Crop No. 73, Fodder Cholam.
Manured—5th October 1943. Sown—6th October 1943. Harvested—5th January 1944.

Plot number and treatment.	Yield of dry fodder (in pound per acre).
1 No manure	1,950
2 N	3,400
3 N + K	3,350
4 N + P	3,525
5 N + K + P	3,750
6 K + P	2,250
7 K	3,300
8 P	2,025
9 Cattle manure	3,360
10 Cattle manure residual	1,133

The complete manure plot (No. 5) gave as usual the highest yield of dry fodder. Nitrogen alone or in combination with phosphoric acid or potash gave higher yields than phosphoric acid or potash alone, indicating that nitrogen was the limiting factor in promoting vegetative growth. Cattle manure also gave yields almost as high as the nitrogen series.

(ii) *The new permanent manurials.*—Panivaragu (crop No. 31) was grown in this series of experimental plots between December 1943 and February 1944. A statement showing yields of grain and straw from the different plots in the eastern and western series is given below :—

New permanent manurials—Crop No. 31, panivaragu.

Manured—4th December 1943. Sown—6th December 1943. Harvested—26th February 1944.

Plot number and treatment.	Yield (pound per acre).	
	Grain.	Straw.
Eastern Series.		
1 No manure	600	1,375
2 N	575	1,900
3 N + K	550	1,637
4 N + P	650	1,775
5 N + K + P	625	2,125
6 K + P	550	1,612
7 K	450	1,575
8 P	575	1,100
9 Cattle manure	575	1,125
10 Cattle manure residual	325	725
Western Series.		
11 No manure	100	250
12 N	425	700
13 N + K	475	975
14 N + P	700	875
15 N + K + P	800	1,600
16 K + P	750	1,250
17 K	625	1,150
18 P	575	1,275
19 Cattle manure	406	1,150
20 Cattle manure residual	387	1,100

NOTE.—The western series received a basal dressing of 2,000 lb. cattle manure per acre for plots 11—18.

The crop on the whole did not receive any special benefit by the application of the basal dressing of cattle manure. The phosphoric acid series, with phosphoric acid alone or in combination with nitrogen or potash or both gave higher grain yields than the rest. The basal dressing appears to have enhanced the combined effects of the N, K and P treatments.

(iii) *Seed-bed manurial experiments.*—Owing to non-availability of fertilizers, particularly superphosphate, it was not possible to continue the experiments during the year. Paddy seedlings were, however, raised and transplanted in the plots as before under 'No manure' conditions, to study the residual effects of the previous manurial treatments. The average yields of grain and straw are given below :—

Details of treatment.	Yield (in pound per acre) (Average of 4 plots.)	
	Grain.	Straw.
No manure, poor seedlings	1,363	1,438
Do. normal seedlings	1,463	1,600
Do. heavily manured	1,638	1,775
Half normal manuring, poor seedlings ..	1,588	1,700
Do. normal seedlings.	1,675	1,713
Do. heavily manured.	1,275	1,425
Normal manuring, poor seedlings ..	1,475	1,688
Do. normal seedlings ..	1,438	1,450
Do. heavily manured ..	1,488	1,725
Average (seedling treatment)—		
Poor seedlings, irrespective of manuring.	1,475	1,609
Normal seedlings, irrespective of manuring.	1,525	1,588
Heavily manured irrespective of manuring.	1,467	1,642
Average (manurial treatment)—		
No manure, irrespective of seedling treatment.	1,488	1,604
Half normal manuring, irrespective of seedling treatment.	1,513	1,613
Normal manuring, irrespective of seedling treatment.	1,467	1,621

The figures do not indicate any significant advantage in favour of seed-bed manuring, as far as residual effect is concerned.

2. *Studies on the nature and extent of decomposition of organic materials of varying C/N ratios in black soils*—(*a*) *Pot culture experiments.*—This investigation, which was started during the previous year, was brought to a close during this year. The analytical data collected for varying periods of decomposition, extending up to 60 days, of different added materials, viz., green manure (sunnhemp), paddy straw, groundnut cake and cattle manure, lead to the following conclusions :—

Organic matter partition.—(i) Progressive and appreciable decrease of organic matter (40 per cent to 70 per cent) in all the samples, the maximum loss being with groundnut cake (70 per cent and over).

(ii) Considerable loss of alcohol-benzene solubles in all the samples (50 to 90 per cent) with a maximum of more than 70 per cent for groundnut cake and 30 to 50 per cent for the other treatments.

(iii) Uniform and all-round reduction of lignins in the treated soils (19 to 55 per cent).

(iv) Fall in the protein values ranging from 20 to 77 per cent for the various samples, the greatest reduction being in the case of groundnut cake.

(v) Very little hemicelluloses and cellulose in the samples except in the case of green manure and paddy straw treated soils.

Nitrogen partition.—(i) The total nitrogen in the various samples has not been affected to the same extent as the organic matter and the losses in the several cases were within the limits of 17 to 40 per cent depending on the nature of treatment.

(ii) Major portions of nitrogen were present in 80 per cent H_2SO_4 extracts and lignin fractions, the extent of these forms of nitrogen not being high except in the case of groundnut cake which has shown a decrease up to 55 per cent in the acid extract.

(iii) Increase of water soluble nitrogen in groundnut cake treated soil and considerable loss of the same in the other treatments.

(iv) Loss of 20 per cent HC_1 soluble nitrogen (8 to 60 per cent) in the different samples depending on the nature of the material subjected to decomposition, the extent of loss being greatest in groundnut cake.

These results in short indicate the possibility of enriching the organic matter and nitrogen in the black soil under irrigated conditions by a judicious incorporation of oil cakes and straw or green leaf so as to maintain the 'lignin-cellulose' and protein in the ratio of 3 : 1 or 4 : 1.

Observations on the influence of decomposing organic materials on the total exchangeable basis in black soil show a very good increase in the total bases at the end of two months after the

addition of organic materials, the order of importance in this respect being cattle manure first, closely followed by straw, green manure and groundnut cake.

(*b*) *Field experiments at Siruguppa.*—The data collected in respect of this investigation which has been in progress for the past four years confirm the observations made in the previous years, viz. :—

(i) Reduction in the average C/N ratios of the treated soils—below 20.

(ii) Increase up to 20 per cent in total N, particularly in the irrigated plots receiving green manure.

(iii) Accumulation of comparatively more organic carbon (10 to 20 per cent) particularly in the fallow irrigated plots treated with green manure.

(iv) Close agreement of the 'oxidation values' expressed in terms of carbon with the absolute organic carbon figures, showing the presence of well-decomposed organic matter free from reducing substances.

3. *The conversion of municipal wastes into compost.*—Due to the fall in imports of artificial fertilizers and the inadequacy of the supply of cattle manure, it was felt necessary to augment the manurial resources of the country for the production of more crops to face the present food crisis by steps such as the preparation of cheap manure by composting municipal wastes and the popularization of such manure among cultivators. As part of an All-India Scheme, an Assistant Agricultural Chemist and a Health Officer from this Province were deputed to undergo training for a period of six months in the Bangalore process of composting under the Chief Biochemist. After this training, 18 Sanitary Inspectors and 2 Agricultural Demonstrators were trained by the Assistant Agricultural Chemist at Vijayavada. On the expiry of this period of deputation on 31st January 1944 he handed over charge to the Health Officer and resumed his duties in the section.

As sufficient data were not available in this Province regarding the efficiency of this type of manure, it has been proposed to conduct field trials with compost prepared out of rubbish and nightsoil from the Agricultural College estate. Pits were dug in Field No. 37, Central Farm, and six pits estimated to yield 30 to 35 tons of finished manure have been filled so far.

4. *Comparative studies of green manures.*—This is a repetition of last year's investigation and consisted in growing the four common green manures, viz., dhaincha, pillipesara, cowpea and sunnhemp in the wetlands 'A' Block with four replications each, obtaining the weight of green matter produced in each case, ploughing in this

green matter in the respective fields and raising a paddy crop (G.E.B. 24) in all the fields to study the relative yields. The data are given in the table below—

TABLE IV.

Green Manure Experiments—With Paddy G.E.B. 24.

(Total area—80 cents.)

(Plots—Lay out.)

North															South
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
D	P	S	C	C	S	P	D	C	S	P	D	D	P	S	C

D=Dhaincha. P=Pillipesara. S=Sunnhemp. C=Cowpea.

Yield of paddy grain and straw due to green manure.

Plots.	Dhaincha.		Pillipesara.		Sunnhemp.		Cowpea.	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.
1	125	111	110	91	101	86	95	76
2	122	104	111	89½	99½	83	108	95
3	110	98	105	93½	100	87	95½	83
4	104	87	107	81	97	88	91	85
Average per plot	115	100	108	88¾	99	86	97	84¾
Per acre.	2,300	2,000	2,160	1,775	1,980	1,720	1,940	1,695

The figures show that in green matter production the green manure crops may be arranged in descending order thus: (1) dhaincha, (2) sunnhemp, (3) pillipesara and (4) cowpea. In point of paddy yields as examined statistically dhaincha again stands first, followed by pillipesara as second, sunnhemp third and cowpea last.

The green matter obtained from these four green manure crops was also tested for organic matter decomposability by adding a unit of the green matter of each to 100 grammes of soil and measuring the amount of CO_2 evolved for a particular duration of time. In this respect the order was cowpea, sunnhemp, pillipesara and last dhaincha. This will be confirmed by further experiments.

5. *Experiments on the storage of farm-yard manure.*—This item of work was included in the three-year programme for 1941–44 but could not be taken up till now for lack of the required facilities. A start was made in February of this year at the Millets Breeding Station with the kind collaboration of the Millets Specialist. A reference made to all the district officers revealed that the views on the subject of manure storage are far from being clear and a definite need for more experimentation exists.

Experiments were therefore started with a view to reexamine the position and particularly to find out the relative crop producing power of manures stored under various systems and whether

manure stored differently does not show response in yields proportionate to its composition and why. These are being conducted in collaboration with Millets Specialist.

Equal quantities of manure (dung and urine) are placed under three different systems of storage (*a*) open heap, (*b*) open pit and (*c*) covered pit by collecting the manure voided by four selected animals and dividing the total collection of each day into three equal parts and placing each under each of the three systems. The collection is made over a period of six months after which time the entire collection under each system is separately weighed, well mixed and analysed. It is proposed to apply the manure soon after removal to the field and test their crop producing values on a crop of late ragi.

The wet weights of the collection during February to July and their analyses are given below :—

TABLE V.

Data on the experiments on the preservation of farm-yard manure.

Serial number and particulars.	Dung.		Urine. (g. per 1,000 c.c. of urine.)		Total.	Remarks.
	Range.	Mean.	Range.	Mean.		
1 Weight of manure—						
(i) Dung (lb.) ..	..	..	..	..	18,178·25 lb.	
(ii) Urine (Gals.).	..	..	..	..	221·25 gals.	
2 Moisture	75·50—81·50	78·91	..	..	..	
3 Nitrogen—						
Wet basis ..	0·37—0·58	0·45	11·68—18·40	14·76	8,180·10 lb.	Total N of dung.
					33·00 lb.	Total N of urine.
					8,213·10lb.	Total N
Dry basis ..	1·79—2·54	2·16	..	..	..	[Total N of dry basis in dung alone.]

Detailed composition of the dung.

Serial number and heads of analysis.	Range.	Mean.	Remarks.
1 Moisture	75·50—80·70	78·49	
2 Ether solubles	..	0·12	
3 Water soluble N	0·49—0·61	0·54	
4 Water Soluble Org. matter ..	3·72—6·46	4·79	Mean of eight estimations.
5 Hemicelluoses	16·48—18·90	17·44	
6 Celluloses	17·76—19·17	18·52	
7 Lignins	17·96—21 65	20·30	
8 Crude proteins	8·06—11·45	9·16	

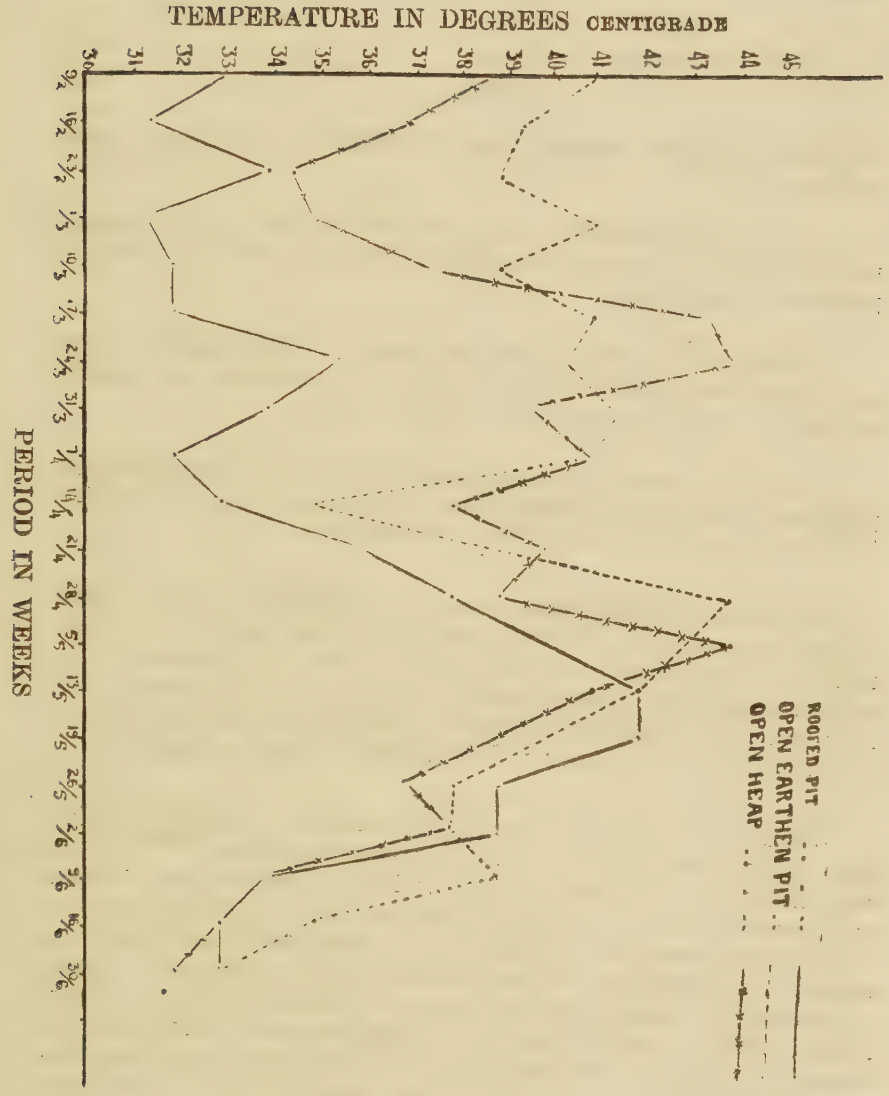
The intensity and general course of fermentation was followed by noting the temperatures of the stored manure periodically. The recorded temperatures are presented graphically. It will be seen that fermentation is generally at a higher level in the open heap and pit and is almost negligible in the covered pit. This was attributed to an unfavourable C : N ratio. The ratio was raised in all the systems by addition of 3 per cent by weight of straw which had the desired effect of inducing a more intensive fermentation.

C.—Plant Chemistry.

1. *Study of quality in chewing tobacco from Jaffna and Meenampalayam* :—During the year, Jaffna and Meenampalayam tobacco crops were grown in Field No. 16, Central Farm. After harvest the leaves of both were cured according to the Jaffna method as detailed in "The Tobacco growing Industry in Ceylon", Ceylon Session paper IX, 1937. Though the instructions given therein were closely followed it was found that at the end of the curing period both the types remained uncured and had the appearance and smell of decayed leaves. The characteristic pungent odour of cured tobacco was absent in both these. The processes were continued for another three months, at the end of which the Meenampalayam type appeared fairly well cured, while the Jaffna variety was not. Microbiological analysis revealed the presence of identical organisms in both. Chemical analysis had to be put off for want of the required reagents.

This investigation has been concluded. The final conclusions arrived at are (1) chemical analysis of samples of cured leaf of the two varieties as received from their respective places of origin showed that Jaffna tobacco contained far less nicotine than the Meenampalayam, and the preference of tobacco addicts in Travancore for the former, and those of Coimbatore for the latter is in all probability due to differences in usage and taste ; (2) growing the two varieties side by side in the Central Farm resulted in the production of a Jaffna type with as high a nicotine content as the Meenampalayam type at all stages of growth and curing and in the cured product ; (3) bacterial flora had nothing to do with the quality of the two types of tobacco ; (4) curing the two types by the two different processes did not show great differences, the Jaffna tobacco cured by the Meenampalayam method yielding a product resembling low grade Meenampalayam tobacco, while curing did not proceed to completion in either variety by the adoption of the Jaffna method ; (5) soil and climatic conditions are the chief factors that influence the quality of the two types. It appears essential therefore that for the production of Jaffna tobacco of the quality that is in demand in Travancore the crop has to be grown on Jaffna soil alone.

2. *The mineral composition of sugarcane as influnced by increasing quantities of manurial nitrogen and by quality of irrigation water.*—This is a continuation of the experiments conducted on nitrogen intake by sugarcane already reported during the previous year. The materials used in this investigation were the same as were employed in the nitrogen intake experiments. The analytical data obtained are summarized below :—


TEMPERATURE IN DEGREES CENTIGRADE
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
PERIOD IN WEEKS
ROOFED PIT
OPEN EARTHEN PIT
OPEN HEAP

Serial number and particulars of treatment.	Cl_2 per cent.	P_2O_5 per cent.	K_2O per cent.
1) 50 lb N per acre irrigated with tap water	0·322	0·111	0·319
(2) 100 lb. Do.	0·345	0·105	0·413
(3) 150 lb. Do.	0·375	0·105	0·442
4) No top dressing of N irrigated with tap water	0·269	0·147	0·365
(5) Do. rain water	0·068	0·153	0·298

From the above average values the following conclusions may be drawn :—

(i) In the manured series chlorine and potash in juice increase with increasing doses of manurial nitrogen while P_2O_5 remains practically unchanged.

(ii) In the unmanured series, irrigation with brackish water has caused an appreciable increase in the chlorine and potash content as compared with rain water irrigation.

(iii) Application of nitrogenous manures appears to depress phosphate ab orption by cane plants, thus revealing an antagonism between the assim.lation of these two radicles.

The inference seems therefore to be justifiable that heavy nitrogenous manuring c upled with brackish water irrigation is detrimental to the quality of juice in that it causes an increase in its chlorine and potash content and a reduction in P_2O_5 content. It may be reca led that the two former are injurious and the latter is beneficial from the jaggery and sugar-makers' point of view.

While the above were general observations, there were individual results that did not fit in with these conclusions. Fresh pot exp riments were therefore started with a view to obtain definite results on the eff ct of salts in irrigation water on the composition of juice with particular reference to nitrogen and mineral constituents. The pot plants did not have good growth, the main stalks in most of the pots having dried up on account of insect attack. Representative material was not therefore available for analysis from several of the pots, and the results obtained were inconclusive. It is proposed to repeat the experiments shortly on the same lines as before.

3. *Storage changes and quality of rice.*—Rice kernal undergoes a change in qua ity as a result of storage. The change mainly affects the nature of its starch and appeared related on the one hand to its molecular size and phosphorus content and on the other to its cooking properties and better marketability. These findings were based on the examination of paddy stored for a period of three months only. Similar examination of the same lot

of seed stored for 9 months is now presented and confirms the indications of last year. The results are given below :—

TABLE VI.

Pre-storage.

Serial number and particulars.	G.E.B. 24		Co3		Co8		Co16	
	C.W.	H.W.	C.W.	H.W.	C.W.	H.W.	C.W.	H.W.
1 Viscosity (relative) ..	1·0091	1·5391	1·0110	1·6177	1·0135	1·5940	1·0214	1·6650
2 Molecular size ..	0·8263	10·667	1·0040	12·360	1·0542	11·620	1·4053	11·997
3 Molecular red. power as per cent R. Maltose.	19·75	1·43	21·84	1·25	24·92	1·61	22·80	1·55
4 Phosphorous content M. Gms. per 100 gms. of dry solids.	3426·0	387·4	3370·0	356·3	4080·0	483·1	2900·0	415·6
5 Vol. expansion per cent.	321·0		213·0		324·0		281·3	

C.W.—Cold water soluble H.W.—Hot water soluble.

After three months.

1 Viscosity (relative) ..	1·0098	1·5155	1·0097	1·5696	1·0120	1·5257	1·0231	1·6384
2 Molecular size ..	0·8742	11·130	0·6812	11·660	0·8092	10·910	1·5170	12·438
3 Molecular red. power as per cent R. Maltose.	18·95	1·50	20·42	1·64	18·39	1·41	18·22	1·45
4 Phosphorus content M. gms. per 100 gms. of dry solids.	3228·0	395·3	3138·0	454·7	3581·0	5286	2952·0	432·7
5 Vol. expansion per cent.	340·7		245·5		342·5		326·0	

After six months.

1 Viscosity (relative) ..	1·0095	1·4479	1·0120	1·5515	1·0095	1·4543	1·0117	1·6096
2 Molecular size ..	0·9846	10·317	0·9118	11·373	0·8173	10·485	0·9333	12·726
3 Molecular red. power as per cent R. Maltose.	13·92	1·18	18·93	1·23	16·03	1·35	15·92	1·36
4 Phosphorus content M. gms. per 100 gms. of dry solids.	2585.0	401·5	2778·0	473·5	3260·0	542·2	1988 0	456·0
5 Vol. expansion per cent.	384·0		275 0		364·3		347·1	

It was pointed out in the last report that with advance of storage, there is noticeable a general tendency for the formation of larger molecular sizes. This inference was based on the viscosity relations of the water soluble fractions of the starch. Further storage has intensified the trend. The changes in the phosphoric acid content also have proved instructive. Its amounts increase in the hot water soluble and insoluble portions while it decreases in the cold water soluble part. There is at the same time a reduction in the amounts of soluble starch of the grain. These results indicate that the larger sizes built up during storage have probably resulted from a process of slow phosphorylatin of smaller polysaccharide units.

D. Animal Nutrition.

1. For want of stalling facilities for animals the activities of this branch of the section remained restricted during the year.

2. *Study of fodder grasses with respect to their hydrocyanic acid content.*—It has been reported already that out of 19 varieties of fodder grasses examined only 4 gave evidence of the presence of hydrocyanic acid at different stages of growth. Of these four varieties, three were toxic in the earlier stages of growth, while a fourth remained so at all stages of growth. Field experiments were started to study the effect of manurial treatment on the HCN content of the four varieties previously examined. Each variety was given six manurial treatments with two controls, and samples were cut and analysed periodically. The work could not be completed, as samples were not available at all stages of growth of the different varieties. A new set of plots have been laid out in which a fresh crop is being grown which would supply material for analysis at all stages of growth. From the results obtained so far it has to be inferred that manurial treatment has no effect on the HCN content of any of these varieties at any stage of growth.

3. *Feeding trials with Giant Star grass.*—The giant star grass (*Cynodon plectostachyum*) was one of the four varieties of fodder grass which were found to contain hydrocyanic acid. In this grass the highest amount of hydrocyanic acid appears to be present at the 'tender' and 'full bloom' stages, and its suitability for feeding to cattle has been questioned. To ascertain the toxicity of the hydrocyanic acid present at different stages of growth of this grass, feeding experiments have been started with a pair of bullocks. The experiments are in progress.

E. Microbiology.

1. *The study of the changes in the microbiological population of black soils as a result of irrigation and manuring* was continued with the second round of post-irrigation samples from the Agricultural Research station, Siruguppa. Analytical data are given in the table below :—

TABLE VII.—*Effect of irrigation on physiological group numbers in black soils, Siruguppa.*

Block Numbers.	Physiological group numbers.					
	Ammonifiers.			Nitrite formers.		
	Pre.	Post 1. Irrigation.	Post 2.	Pre.	Post 1. Irrigation.	Post 2.
III	10,000	1,000,0 0	50,000	11	100	50
V	10,000	1,000,000	1,000,000	Nil.	1,000	500
VII	100,000	100,0 0	50,000	109	55	100
VIII	10,000	100,000	500,000	11	550	500
Block Numbers.	Per gram soil.					
	Nitrate formers.			Nitrogen fixers.		
	Pre.	Post 1. Irrigation.	Post 2.	Pre.	Post. 1. Irrigation.	Post 2.
III	Trace.	100	5	550	100	500
V	Do.	1,000	5	1,090	1,000	5,000
VII	Do.	1 000	5	109	109	1,000
VIII	Do.	1,000	100	500	100	1,000

The data show that between the first and second round samples there has been a slight decrease in the physiological group numbers, except in the case of nitrogen fixing organisms. The greatest reduction was seen in the nitrate forming bacteria. This does not, however, mean that the soil is being depleted of these physiological groups but rather that the total numbers of the various kinds of organisms are gradually getting stabilised in conformity with the treatments and manuring to which the fields are subjected. This is confirmed by the total bacterial population in the different fields, which were found to be so grouped as to be indicative of the treatments given to the fields.

2. *Nitrogen fixation in paddy soils.*—As in previous years, molasses was added to soils, and after completion of fermentation the soils were inoculated with Azotobacter, Clostridium and a mixture of the two bacteria in different pots. Paddy (G.E.B.24) was planted in the pots and each treatment was replicated eight times. There were two controls, one with soil only (no molasses and no inoculation) and the other soil with molasses only (no inoculation) each having eight replications as the others.

The yields of paddy in the different series are given below:—

TABLE VIII.—*Second set.*

Oxygen demand of drainage water (M. gms. per 100 c.c.) yield.

Pot number and treatment	3 Min.	30 Min.	Difference.	Grain.	Straw.
1 No molasses—No inoculation ..	0·40	1·28	0·88		
2 ..	0·29	0·94	0·65		
3 ..	0·30	0·96	0·66		
4 ..	0·35	0·94	0·59		
5 ..	0·42	1·25	0·83		
6 ..	0·40	1·81	1·41		
7 ..	0·48	1·36	0·88		
8 ..	0·53	1·27	0·74		
Total ..	3·17	9·81	6·64		
Average ..	0·40	1·23	0·83	3·17	5·39
9 Molasses alone—No inoculation ..	0·37	1·71	1.34		
10 ..	1·60	6·00	4·40		
11 ..	0·29	1·21	0·92		
12 ..	1·23	4·31	3·08		
13 ..	2·90	8·89	5·99		
14 ..	2·50	8·89	6·39		
15 ..	0·69	2·55	1·86		
16 ..	1·36	4·82	3·46		
Total ..	10·94	38·38	27·44		
Average ..	1·37	4·80	3·43	4·20	9.81
17 Molasses + Azotobacter ..	2·19	6·15	3·96		
18 ..	2·64	7·79	5·15		
19 ..	1·75	5·82	4·07		
20 ..	0·52	1·90	1·38		
21 ..	1·74	5·93	4·19		
22 ..	0·27	1·11	0·84		
23 ..	0·32	0·88	0·56		
24 ..	1·03	3·40	2.37		
Total ..	10·46	32.98	22·52		
Average ..	1·31	4·12	2·81	8·82	13·26

Oxygen demand of drainage water (M. gms. per 100 c.c) yield.—*cont.*

Pot number and treatment	3 Min.	30 Min.	Difference.	Grain.	Straw.
25 Molasses + Clostridium ..	1·12	3·50	2·38		
26 ..	0·53	1·05	0·52		
27 ..	0·30	1·16	0·86		
28 ..	0 62	1·35	0·73		
29 ..	3·73	10·04	6·31		
30 ..	1·30	4·41	3·11		
31 ..	0·42	1·82	1·40		
32 ..	0·43	1·26	0·83		
Total ..	8 45	24·59	16·14		
Average ..	1·06	3·07	2·01	4·04	9·04
33 Molasses + Azotobacter ..	1·47	4·97	3·50		
34 + Clostridium ..	0·65	2·59	1·94		
35 ..	1·19	3·65	2·46		
36 ..	0·52	1·72	1·20		
37 ..	0·95	3·24	2·29		
38 ..	1·59	5·07	3·48		
39 ..	1·97	6·37	4·40		
40 ..	0·96	3·75	2·79		
Total ..	9·30	31·34	22.04		
Average ..	1·16	3·92	2·76	3·99	7·55

The yield was highest in the Azotobacter inoculated series, being more than double that of all other treatments. In Clostridium and the series obtaining Clostridium plus azotobacter, the yield was slightly lower than even the molasses control.

No definite conclusions can be drawn from these data since they do not agree with the previous results. The investigation will be repeated this year and continued only if comparable data are obtained.

F. Agricultural Industries.

1. *The preparation of agar-agar from sea-weed.*—The method of preparing agar-agar from the sea weed (*Gracilaria lichenoides*) which is found in abundance on the South-east Coast of the peninsula was outlined in the last annual report. It has been found possible to obtain from this weed a product which has been certified to conform to the B. P. standard and suitable for the cultivation of micro-organisms. Further work done during the year under report aimed at the reduction in manufacturing cost as well as in operational time.

The use of distilled water for soaking and extraction would naturally maintain the cost of production at a high level. It was calculated that 30 litres of distilled water would be required to treat 100 grams of bleached weed, which yields about 20 grams of agar-agar. Attempts were therefore made to substitute water

of varying qualities available locally. Analysis of the final product as prepared with water containing different amounts of total solids is given in table below:—

TABLE IX.—*Analysis of agar—Agar prepared with different kinds of water.*

Source of water.	Total Solid parts Per 100,000.	Moisture.	Per cent on dry basis.		
			Ash.	Insolubles.	Nitrogen.
Estate tap water	186	9·88	12·61	..	0·14
Well water. F. No. 75 ..	85	11·66	11·63	..	0·14
Well water ½ + Town tap water ½ (Siruvani).	45·2	15·83	7·40	..	0·10
Well water ¼ + Town tap water ¾ (Siruvani).	26·4	9·40	6·39	..	0·84
Town tap water only (Siruvani) ..	6·6	16·46	4·87	..	0·10
Rain water ..	8·9	8·12	5·14	0·28	0·10
Distilled water ..	nil	16 0	3·60	..	0·17
Difco Brand Agar ..	..	17·48	3·00	..	0·22
B.P. Standards ..	..	18	5	..	1

The figures indicate that the ash content varies with the salt content of the water used, the percentage of ash remaining fairly constant with the use of water containing 85 parts and over of salt per 100,00). Below this limit a small decrease in total solids is accompanied by a big drop in ash content. With the use of rain water an agar-agar was obtained which had a slightly higher ash content than the maximum prescribed for the B P. standard, and with the use of Coimbatore Town Supply-water (from Siruvani) the ash content could be brought down to a level just below this maximum. It is therefore fortunate that with the plentiful supply of suitable water available locally, the cost of production could be materially reduced.

Hydrochloric acid would be another costly item in the large-scale production of agar-agar. Experiments are in progress with a view to completely dispense with the use of this reagent or at least to reduce the strength required for effectively washing the raw weed. Different dilutions such 0·5 per cent, 0·25 per cent, 0·1 per cent and no HCl at all are being tried in the place of 1 per cent HCl now used.

Experiments are also under way to reduce operational time by working out the minimum steeping period for the purification of the jelly. Studies will also be made of the nature of purification obtained, i.e., how and to what extent the ash and nitrogen contents of the crude jelly are reduced by the steeping process.

2. *Dehydration of potatoes.*—Investigators in Russia have found that by utilising the tips containing the buds alone for the propagation of the potato crop, about 75 per cent of the tuber could be saved for domestic consumption. The cut potato tubers are not

suitable for marketing as such, but by dehydrating them it would be possible to send them to long distances or store them for use in times of scarcity. A method of dehydration has been worked out in this laboratory. It consisted in peeling and slicing the tubers (after removal of the tips) to a thickness of about 1/8 inches, blanching the slices in boiling salt water for not more than 5 minutes, chilling in a stream of cold water and drying them on screen trays in a draught oven for 8 hours or more at a temperature of about 150°F. Potato chips prepared this way were cream coloured, translucent and crisp, and were found to keep indefinitely. A charcoal heated draught oven for drying has been designed by the Research Engineer. The District Agricultural Officer, the Nilgiris' has been instructed in this method of dehydration which could be adopted as a cottage industry in the potato growing areas of that district.

3. *Malting of cholam.—Studies on the preservation of cholam malt food.*—One of the chief causes of rapid deterioration of cholam malt food is the rancidity developed on account of its high fat content (3·5 4·2 per cent). It was therefore considered necessary to find ways and means of reducing its fat content. The following three methods are being tried:—

(*a*) *Steeping cholam grain in weak alkali instead of water.*—The idea is to have at least a portion of the fat in the grain saponified by the alkali and removed during the steeping process. Different strengths of sodium and potassium hydroxides and slaked lime from 0·1 per cent to 0·5 per cent were used, with rain water as control. The experiments were run for a period of three months. The results indicated that in all cases including the controls the percentage of fat in the malted food was 25 per cent less than in the grain before steeping, and that alkali treatment at the strengths given above in no way removed more fat than treatment with water alone. When stronger alkali was used (0·5 per cent or more) germination was affected, and the experiments were therefore discontinued. It is proposed to treat cholam kiblings with weak alkali and study the effect of such treatment on the fat content of the malt.

(*b*) *Choosing cholam varieties with low fat content for malting.*—On an examination of analytical data in respect of a number of varieties of cholam, indigenous as well as imported, it was considered possible that M. 47–3 might be a suitable variety for malting purposes on account of the low percentage of ether extractives in the grain. This is a Mohol type, white grained and bold, suited to dry conditions, and is rapidly replacing T. I. Jonna in the dry land areas of Ceded district. Malt food prepared from this variety was analysed at intervals of one month, and was found to have a low acid value, and to retain its quality and aroma even after four months, though no special precautions such as paraffining the lid, etc., were taken in its preservation. It is hoped that this line of work may be productive of useful results.

(c) *Blending of cholam and paddy malts.*—Paddy malt has a lower fat content (about 2 per cent and might be blended with cholam malt to produce a food of better keeping quality. Experiments in this direction also are in progress.

The infestation of bottled malt food by insects necessitated the pursuit of investigations on suitable methods of preventing this type of deterioration. Filling the bottles with carbon dioxide after exhausting the air and raising the temperature of the bottled food to a level at which insects could not live and breed, were two of the remedies tried.

(a) *Carbon dioxide treatment.*—Experiments were started in collaboration with the Government Entomologist to test the efficacy of this treatment in preventing insect infestation. Estimation of the quantity of CO_2 present in the bottles as packed for sale at the factory, its adequacy to prevent the appearance of insects at all stages of growth, and the degree of retention of the gas on keeping under different systems of sealing and packing are the items on which attention is being bestowed. Experiments on the retention of carbon dioxide in the bottled product are summarised in the following table:—

TABLE X.—*Carbon dioxide retention in malt bottles treated differently.*

Treatments numbers.	Vol. of gas handled.	Co2 in the sample.	Per cent Co2 in the sample i.e., on the absolute air space in the malt bottle.	Difference of percentages over control.
	c.c.	c.c.		
1 Malt bottle closed in the rubber bung after C02 exposure—Control.	33·2	11·4	34·3	
2 Malt bottle closed with metallic screw cap provided with rubber ring.	34·8	11·8	33·9	0·4
3 Malt bottle closed with metalic screw cap embedded with discs of tissue paper and card board disc dippedjin hot paraffin.	34·8	9·6	27·6	6·7
4 Same as 3, but for the fixation of the tissue paper to the rim of the bottle with dextrin paste containing a small quantity of Cu S04 or borax.	34·2	7·2	21·1	13·2
5 Same as 4, but for the use of Casein paste.	34·6	9·9	28 6	5·7
6 Same as 3, but for the use of Cork sheath.	34·0	9·2	27·1	6·2
7 Same as 6, but for the use of dextrin paste.	34·7	10·7	30·8	3·5
8 Same as 7, but for the use of Casein paste.	34·2	8·6	25.1	9·2

Remarks.—* Treatments 1 and 2 are the best followed closely by Nos. 7, 5, 3 and 6.

From these figures it is evident that the gas can be retained efficiently and at a small cost by sealing the bottles with discs of tissue paper and cardboard dipped in paraffin using dextrine or starch paste containg very small quantities of borax or copper sulphate.

With all these precautions to retain CO_2 in the bottles, it is to be doubted whether the displacement of air by any inert gas will be alone adequate to preserve the product in its original purity for a reasonable period under normal conditions of storage. The presence of air cells in the fine malt particles induces tallowiness and rancidity of the food in course of time. This defect can be remedied only by processes such as pressing the food between steam rollers under pressure so as to remove the occluded air, as is being done in the manufacture of milk powder.

(*b*) *Heat treatment.*—It was found that by keeping the malted food at a temperature of 55°C the breeding of insects at all stages of growth could be prevented. To attain this temperature at the centre (centre of the bottles,) the latter has to be kept in an oven at 95°C for about an hour, or for longer periods at 75–85°C. Studies made on the malt food so treated show that the keeping quality was not impaired even for a period of 3 months.

Increasing the production of malt extract.—Various methods of enhancing the yeild of extract with a view to lessen the cost of production are being investigated. By treating the residue in the still after extraction with green malt, it may be possible to saccharify the starch still left in it. By the addition of starch from external souces like tapioca, arrow.oot, etc. to the course malt and saccharification with green malt it may be possible to increase the output of malt extract. The efficacy and economics of these processes are being investigated.

4. *The preparation of Cocoa powder from indigenous pods.*—Cocoa pod from the Kallar gardens were kindly supplied by the Fruit Specialist for experiments on the preparation of cocoa powder similar to the imported materials. The method adopted is summarised below:—

The ripe pods were split open and the cocoa beans removed with the adhering pulp and packed into a wide mouthed bottle which was maintained at a temperature of 30–35°C for four to five days, during which fermentation had advanced to a sufficient degree. After this preliminary treatment the beans were dried in the sun for a few hours and then roasted at a temperature of 130°–140°C in an electric oven till the characteristic odour of cocoa was developed. The beans were then rapidly cooled, the shells removed, and the kernel crushed and pressed hot in a hydraulic press to remove as much of the fat (cocoa butter) as possible. The residue was powered and passed through a 60-mesh sieve.

'*Soluble*' *cocoa.*—The brands of cocoa obtained in the market are marked 'soluble cocoa'. These are prepared from the crude product obtained as described above by processes which are kept as trade secrets. As far as could be gathered from literature, solubilisation is effected by treatment with alkali. Attempts were made to make soluble cocoa similar to the market product out of the deffatened powder. Trials were made by treating it with

solutions of different strengths of Sodium Carbonate, Potassium Carbonate (Dutch method) Ammonium Carbonate (German method) and Potassium and Sodium Hydroxides, and autoclaving for one hour at 120°C and 19 lb. pressure Of these, treatment with 3 per cent Sodium Carbonate appeared the most promising.

Below are given the analytical data in regard to cocoa thus rendered soluble as compared with the crude defattened powder, and the 'Van Houghton' and 'Rowntree' cocoas purchased in the market.

Heads of analysis.	Defattened Cocoa powder as prepared in the laboratory.	Soluble Cocoa as prepared in the laboratory.	Van Houghton's Cocoa.	'Rountree' Cocoa.
	PER CENT.	PER CENT.	PER CENT.	PER CENT.
Moisture	4·07	7·13	5·32	7·57
Ash	5·38	5·12	7·91	6·81
Soluble Ash	2·08	2·50	6·65	5·20
Alkalinity as K_2O ..	2·60	3·50	3·77	3·94
Siliceous matter	0·069	0·17	0·048	0·088
Cold water extract ..	3·17	1·59	5·15	5·08
Proteins	18·48	15·11	22·29	22·52
Fat	55·25	34.73	25·74	20·57
Crude fibre	5·85	3·71	0·25	0·64
Alkaloids	1·32	0·68	1·89	0·68

These figures show that the cocoa prepared from local pods has not reached the standard of imported cocoas in protein, and cold water extract, and contains more of fat than the latter.

5. *Preparation of biscuits from gingelly cake.*—At the instance of the Deputy Director of Agriculture, Southern Division, laboratory experiments were carried out to investigate the possibility of making biscuits out of gingelly cake which was available in large quantities. Biscuits require a weak flour with a low protein content, hence the possibility of utilising the cake as such had to be ruled out. The powdered cake was, however, incorporated into American flour in different proportions and the quality of biscuits prepared out of such mixtures examined. In the first instance the presence of sand and other extraneous matter in the cake as usally obtained was a serious impediment to its being used as human food. With more than 4 oz. of cake meal in 10 oz. of flour, the biscuits were tough and dark coloured, and had an unplesant taste which could not be masked even by the addition of cocoa. The presence of the black husk is likely cause of the unattractive colour and taste of the biscuits. With a clean cake from husked seeds it may be possible to prepare biscuits of good quality.

6. *Preparation of alkali from 'Choudu' or washerman's earth.*—This investigation was taken up with a view to find out a cheap source of alkali for activation of carbon, as caustic soda has become costly and scarce owing to war conditions. 'Choudu' or washerman's earth is known to contain varying amounts of sodium

carbonate according to the locality in which the deposits are found. By treating a water extract of this earth with quick lime it should be possible to get a weak solution of sodium hydroxide which could be concentrated and purified into a low grade caustic soda. Bulk trials were made with deposits collected locally, but the process was not found to be economical, as the local earth was poor in carbonate content. Samples were called for from the districts of Tinnevelly, Cuddapah and Bellary. The samples received from Tinnevelly were poor in carbonate, while those from Rayadrug and Hadagalli taluks of Bellary district and Pulivendla taluk of Cuddapah district, contained high percentages. A regular survey of likely areas might lead to the dicovery of further deposits with high carbonate content, which could be utilised for the manufacture of caustic soda on a commercial scale.

COIMBATORE,
7th August 1944.

H. SHIVA RAU,
Government Agricultural Chemist.

ADMINISTRATION REPORT OF THE GOVERNMENT ENTOMOLOGIST FOR THE YEAR 1943-44.

I. Charge.

I continued to be in charge of the section as Entomologist.

II. Advisory.

Eight hundred and fifty three enquiries from different parts of the Presidency were received and attended to. Of these 341 were dealt with by the headquarters staff and the rest by the Entomological-cum-Mycological staff stationed in the districts. Most of the enquiries related to insect pests of crops and their control and bee-keeping. A short account of this is given under the item " Propaganda and Campaign."

III. Teaching.

The following lectures and practical classes were held during the year :—

Class.	Lectures.	Practical classes.
B. Sc. (Ag). Degree Course—		
Class I	60	30
Class II	35	31
Short course in insect pests	17	17
Short course in bee-keeping	10	11

IV. Special Investigations on Crop Pests and Their Control.

Pests of cotton.

1. *The cotton bollworm.*—(*Platyedra and Earias*).—Studies on the control of the bollworms by liberating the *Trichogramma* egg parasite were continued. Parasites at the rate of 10,000 per acre were liberated in two fields and two fields were kept as control. In all 21 liberations were made. Trends of reduction in bollworms incidence are noted in the released plots as may be seen from the figures given below for five fortnights commencing from February :—

	Percentage of bolls affected.				
	February I. F.	February II. F.	March I.	March II.	April I.
Experiments I	23·1	17·2	15·5	24·6	29·9
Control I	21·4	29·1	35·8	40·3	65·8
Experiments II	22·5	18·4	26·6	47·3	58·7
Control II	31·5	34·1	31·5	30·5	53·2

2. *The cotton stem weevil* (*Pempherulus affinis*).—The seasonal incidence of the crop was studied. As in the previous year the incidence reached cent per cent in the last three months—April to June. There was no case of parasitism. Studies on the alternate host plants were continued. Of the seven species examined, viz., *Triumfetta rhomboidea*, *Sida acuta*, *Sida spinosa*, *Malvastrum sp.*, *Hibiscus ficulens*, *Hibiscus vitifolius*, and *Abutilon sp.*, the first four alone showed infestation. *Triumfetta rhomboidea* showed high degree of infestation. Three species of parasites *Entedon sp.*, *Dinarmus sp.*, and *Spathius labdacus* were noted.

3. *The cotton leaf roller* (*Sylepta derogata*).—During the year under review the incidence of the pest was light and hence no control measures were attempted. Parasitism was also scarce.

Pests of sugarcane.

Sugarcane borers (*Argyria*, *Diatraea* and *Scirpophaga*).—The percentage of infestation by borers was lower with an average of 15·7 as against 25·6 of the previous year. *Argyria* was prominent in the earlier stages of growth whereas *Diatraea* was more pronounced in later stages. *Scirpophaga* was found throughout the growth of the cane but the percentage of infestation was insignificant.

During the year under review the following parasites were recorded : (1) *Telenomus* and *Trichogramma* on eggs of *Argyria* and *Diatraea* and *Telenomus* and *Tetrastichus* on *Scirpophaga* eggs, (2) *Stenobracon deesae* and *Apanteles flavipes* on larvae of *Argyria*, (3) *Rhaconotus* sp. and *Apanteles flavipes* on Diatraea larvae and (4) *Rhaconotus scirpophaga* and *Elasmus zehntneri* on larvae of Scirpophaga.

Studies were made on the incidence of borers on alternate host plants. About 28,500 *Saccharum spontaneum* plants were examined the percentage of infestation of *Argyria Diatraea*, *Scirpophaga* and *Busseola sacchariphaga* being 0·5, 1·4, 4·8 and 17·0 respectively. In 845 Sorghum plants examined 79 borer stages were recovered and all of them with the exception of a solitary specimen of *Diatraea* were *Chilo zonellus*. A few specimens of *Shirakia* parasites were reared from *Scirpophaga* on *Saccharum spontaneum*.

Of the three varieties of cane studied, viz., Co. 413, Co. 419 and Co. 421, the second appeared to be more susceptible to borer attack in the growing stage of the crop but at harvest little or no difference was noted among them.

Control trials.—These were conducted at Nellikuppam. The egg parasite—Trichogramma—was bred in large numbers and liberated in the experimental fields at the rate of 8,000 per acre

per liberation. The effect of six and twelve liberations was studied. Figures for borer incidence and yield from the released and control fields are as follows :—

	Borer attack. PER CENT.	Yield in tons per acre.
Control	32·2	22·11
Six liberations	24·1	24·04
Twelve liberations	21·3	32·46

It will be seen from the above figures that perceptible reduction of borer incidence and consequential higher yield are noted in the 12 liberation fields as against the control. The money value of the former works out to Rs. 46 per acre and that of the latter to Rs. 248 at Rs. 24 per ton inclusive of bonus paid to the ryots. The cost of treatment was Rs. 12 and Rs. 24 for the six and twelve liberations of parasites, respectively.

Pests of chillies.

The chillies thrips (*Scirtothrips dorsalis*).—Studies on the varietal resistance to thrips were continued. Twenty-five varieties were tested during the year. The nursery was sown on 29th June and the seedlings were transplanted on 19th August. In the earlier stages the crop suffered badly from drought and later in October-November suffered a set back due to continuous wet weather and water-logged conditions. There were five counts of thrips population and four pickings for yield. The data collected were analysed statistically and the results are given below :—

(1) No statistical significance was obtained for population of thrips among the different varieties tested.

(2) With regard to yield, though a selection of Kathiawar gave higher yields than the local it was statistically on a par with the local and seven other varieties.

Pests of paddy.

1. *The paddy stem borer* (*Schoenobius incertellus*).—Having found that light trapping with hurricane lights is effective in reducing the stem-borer incidence, studies were made to determine the flight range of moths by marking them and releasing them from known distances. Moths, released at distances of 50 yards and 100 yards were attracted to huricane and petromax lights, respectively. Further trials with longer distances are in progress.

2. *The paddy mealy bug* (*Ripersia oryzae*).—The seasonal incidence of the pest ranged as follows :—

Kuruvai ..	0·6 to 0·9 per cent.
Thaladi ..	1·5 to 6·0 ,,
Samba ..	0·3 to 2·0 ,,

Infestation in Kuruvai varieties Adt. 3, Adt. 18 and Adt. 20 showed 0·9 per cent, 0·6 per cent and 0·8 per cent, respectively.

In Thaladi crop Adt. 2., Adt. 11, Adt. 17 showed 3·5 per cent, 6 per cent and 1·5 per cent infestation, respectively. The incidence in samba varieties were 2 per cent, 0·5 per cent, 0·5 per cent, 0·3 per cent, 1·4 per cent and 0·7 per cent in Adt. 1, Adt. 2, Adt. 8, Adt. 13, Adt. 17 and Co. 16, respectively.

Experiments were laid out at Aduturai to test the effect of scorching of the nursery bunds prior to sowing and planting out the seedlings therein as a measure of control against the pest. There was less incidence of the pest in the treated plots than in the control but no significance for yield was established due to the low incidence of the pest during the year.

Pests of fruit trees.

1. *The citrus leaf miner* (*Phyllocnistis citrella*).—Control trials have confirmed the superiority of tobacco extract as a toxic agent against the leaf miner. As a deterrent, fornightly sprays of Thevet a extract at a strength of one oz. in one gallon of water have given good results. The comparative effect of fortnightly and monthly sprays is being studied. Of the 17 varieties of citrus under observation, Sathgudi and Pomello showed less incidence of the pest than the rest.

2. *The mango hopper* (*Idiocerus spp.*).—The two treatments sulphur dusting and fish-oil rosin soap spraying have given increased setting of fruits as against that of the controls. As between the treatments no perceptible differences in setting of fruits were noted. The hopper attack was mild this year while thrips was found in some numbers.

3. *The apple woolly aphis* (*Eriosoma lanigera*).—The parasite—*Aphelinus mali*.—introduced in the Nilgiris for the control of the wooly aphis continued to be effective against the pest. An examination of the orchards in Kodaikanal has shown the presence of pest there. As there was no evidence of the parasite in this area arrangements have been made to send a consignment of the parasite.

4. *The San Jose scale* (*Quadraspidiotus perniciosus*).—A survey of the newly recorded and much dreaded pest of fruit trees—The San Jose scale—was made in the Nilgiris, Kodaikanal and Shevroys to study the extent of spread of the pest. Various fruit trees and other plants were examined and the scales collected were mounted on slides and examined. So far, apples and peaches alone are found affected in small numbers in Coonoor and Kotagiri. These trees are being treated against the pest.

Pests of oil-seed crops.

1. *The castor semi looper* (*Achaea janata*).—Control of the pest was attempted by release of the egg parasite *Trichogramma*. The

trials have given satisfactory results. There was very little incidence of the pest in the treated plots. Possibility of keeping parasitized Corcyra eggs in cold storage and using these for emergencies was indicated on the basis of the studies made so far. The eggs can be kept in cold storage for a period up to 50 days without unduly impairing the percentage of emergence of the parasites.

Two more host plants—*Euphorbia hypersifolia* and *Cardiospermum Halecacabum* of the pest have been noted for the first time.

2. *The gingelly caterpillar* (*Antigastra catalaunalis*).—In the insecticidal trials undertaken at the Agricultural Research station, Tindivanam, spray of Acorus alone gave promising results while the rest, viz., *Bordeaux mixture*, *Calcium arsenate* and *Oil emulsions* gave indifferent results.

Pests of coconut.

1. *The coconut caterpillar* (*Nephantis serinopa*).—The pupal parasite—*Trichospilus pupivora*—was reared in numbers at the insectary and liberated in the infested gardens in the villages of Nanjundapuram and Ramanathapuram. It is gratifying to note that the introduced parasites were recovered from the gardens and the pest has subsided in the locality. A maximum of 539 parasites have emerged from a single parasitized host pupa.

2. *The coconut beetle* (*Oryctes rhinoceros*).—Trials with the green muscardine fungus parasitic on beetle grubs were continued at the Insectary, Coimbatore, and the West Coast coconut stations. At the insectary there were two open pits and one caged pit. In the open pits the fungus was recorded for all the twelve months but the number of affected grubs was few. In the caged pit all the 50 grubs introduced each month succumbed and in some months infection was complete within a fortnight. The insectary cage pit material served as a reservoir of culture manure for fresh inoculations elsewhere. In the West Coast stations, the fungus attacked specimens were few in number and so the culture material from all the four stations was tested at the insectary in pots and pits. It was found that the fungus is present in the material from all the stations. In pots the response was seen in the course of a month while in pits the response is rather slow. The pits are under further observation.

Pests of vegetables.

1. *The brinjal budworm* (*Phthorimoea blapsigona*).—The maximum percentage of incidence of the pest in the brinjal crop transplanted in July 1943 was 58·4. In the crop transplanted in February 1944 the maximum percentage of incidence was only 16. Control treatments against the pest consisted of fortnightly spray of (1) *Calcium arsenate* plus *lime*, (2) *tobacco decoction*, (3) *Bordeau* mixture and (4) *Thevetia* oil emulsion with suitable controls. The yields in different plots are recorded to judge the effect of the

treatments. Shed buds are also being examined to note the percentage of incidence. Observations are also made on the effect of the different treatments on other pests of brinjal. The trials have not been concluded. So far, *Calcium arsenate* plus lime and Thevetia oil emulsion have given better results than the rest.

2. *The sweet potato weevil* (*Cylas formicarius*).—A serious outbreak of the pest in the Central Farm was investigated. There were two varieties of sweet potatoes—One red and the other white. The damage was found to be 86 per cent in the white and 93 per cent in the red variety. Control experiments were started. Dusting the plants with *Calcium arsenate* and lime was effective against the adult beetles. Oil emulsions as deterrents did not give satisfactory results.

Pests of coffee.

The coffee white borer (*Xylotrechus*).—As a result of the investigations conducted in the Palani-Bodi-Sirumalai hills in the Madura district, it was found that the white borer is a very serious pest of coffee in Lower Palnis and Sirumalai groups. The pest was found in a severe form in estates where the coffee plants were in a poor condition due to poor soil, dry surroundings, want of shade, proper manuring and general neglect. One of the methods of reducing infestation is by pulling out attacked plants and destroying them by burning.

Pests of wattles.

The fluted scale (*Icerya purchasi*).—The Nilgiris and Kodaikanal areas were surveyed for noting the incidence of the pest. In the Nilgiris the spread of the pest in Ootacamund and Coonoor taluks is confined so far to the area connecting Naduvattam in the west, Avalanche in the south, Coonoor in the east and Tuneri in the north with another belt along the Coonoor-Kotagiri road up to Kotagiri. In all 14 localities were marked out for immediate release of the predator. In the Kodaikanal taluk the pest was noted along the contour of 6,000 feet and above with Kambum in the west, Kukkal in the north, Korapur in the east and Mariashola in the south. The pest has recently been found in the citrus gardens of Perumalmalai at an elevation of 4,500 feet. Outside Kodaikanal there is stray occurrence of the pest at Top station in Periyakulam taluk. The scale is found on Acacias and citrus along the Kodaikanal-Cochin road up to Munar and Devicolam area in Travancore State.

Mass breeding for liberation of the predator—*Rodolia cardinalis*—was done both in the Nilgiris and Kodaikanals for the control of the pest on wattles. During the year under review 5,350 beetles were liberated in different affected areas in the Nilgiris and 3,000 in the Kodaikanal area the rest being used for breeding purposes in the Laboratory. As a result of the liberations there is reduction in pest incidence.

Three new Icerya plant hosts—*Oenothera Ciennis*, *Senecio wightianus* and *Impatiens chinenzis* were recorded.

Other items of research under study were (1) methods of shortening the life cycle of the predator in winter, (2) preference of the pests to different host plants, (3) local natural enemies, other than *Rodolia roseipennis*, (4) the number of generations of the pest and predator in the year, (5) *Rodolia* feeding trials on other hosts and (6) method of sending Rodolia by post.

Plant quarantine stations were established at Mettupalayam and Gudalur for the Nilgiris and Shembaganur and Top station for the Kodaikanal area and the scheduled plants were allowed only after fumigation with HCN (Hydro Cyanic acid gas).

Pests of stored products.

1. *The potato tuber moth* (*Phthorimoea operculella*).—Dusting the tubers with Pyrethrum, Acorus, Derris and tobacco dusts with suitable controls was under trial. Each treatment tray had 125 tubers and was replicated six times, the variety tested being Great Scot. The percentages of infestation in the different trials are given below :—

	Expt. 1.	Expt. 2.	Expt. 3.	Expt. 4.
Date of dusting	June 1943.	September 1943.	February 1944.	February 1944.
Date of examination	October 1943.	February 1944.	April 1944.	April 1944.
Percentage infestation in Pyrethrum.	Nil.	Nil.	Nil.	Nil.
Percentage infestation in Acorus ..	Nil.	Nil.	Nil.	Nil.
Percentage infestation in Derris ..	Nil.	Nil.	Nil.	Nil.
Percentage infestation in tobacco ..	5·2	0·5	0·8	0·4
Percentage infestation in control ..	10·0	3·2	4·3	2·6

It will be seen from the table that Pyrethrum, Acorus and Derris have been very effective in controlling the pest.

2. *Pest of cholam malt* (*Tribolium* sp.).—The following are the results of the studies made so far on the malt pest—*Tribolium* sp. —and its control: —

(i) In bottles filled with malt and charged with Co_2, for 1, 5, 10 and 15 minutes and closed with screw caps as was done previously at the malt factory the different stages of the beetles were not killed due to the poor retention of the gas in the bottles.

(ii) In the case of bottles filled with malt and charged with Co_2 for ten minutes and closed with screw cap and paraffined up to the neck of the bottle, Co_2 retention ranged from 17 to 30 per cent in bottles examined after one day (17·02 per cent Co_2) and after two days (22·2 per cent Co_2), complete mortality of the different stages of the insect was not obtained. Bottles examined after five days (30 per cent Co_2) eight days (29.9 per cent Co_2), twelve days (26.5 percent Co_2) and after fifteen days

27·9 per cent Co. $_2$) showed complete mortality of the different stages of the beetle while in the control (without Co. $_2$) most of the insects were alive. Retention of Co. $_2$ is therefore essential for giving cent per cent mortality.

(iii) Heat treatment was also tried with successful results. A series of trials with different temperatures have shown that 55 ° C. for ten minutes was the lethal temperature for the pest. All the stages of the pest are killed at this temperature.

(iv) Paraffining of the metal caps up to the neck of the bottle was also effective in preventing infection from outside.

(v) Life cycle, longevity and fecundity of the pest were studied. The life cycle of the pest ranged from 39 to 49 days. The maximum longevity of the beetle is about eight months and the maximum egg laying 300. It will be seen that even a small number of beetles present in the malt food bottles at the beginning will give rise to a large number to infest the food.

3. *Pests of rice* (*Calandra Rhizopertha* and *Tribolium*).—Incidence of pests in rice under natural conditions of storage was studied. Trials were conducted in the Central Farm with raw and parboiled rice of both handpound and milled series in gunny bags with 25 lb. of grain replicated four times. Co. $_2$ was used for the test. Population counts of insects infesting stored rice were taken once a fortnight from one pound sample each. The table given below gives the total population of insects in rice bags at the end of six months of storage :—

Total population of insects in rice bags at the end of six months (June to November 1943).

Grade or polish.	Parboiled.			Raw.		
	Tribolium.	Calandra.	Rhizopertha	Tribolium.	Calandra.	Rhizopertha.
Handpound.	251	37	1,252	1,275	90	1,627
First Milling.	325	62	4,154	1,317	132	16,002
Second Milling.	107	23	943	945	207	1,200
Third Milling.	62	8	482	326	32	704

It is seen from the table that (1) raw rice is more heavily infested than parboiled rice, (2) the second and third milled rice have less of pests than first milled and handpound, and (3) the first milled rice carries strikingly a much higher population of *Rhizopertha* than handpound rice. The behaviour of *Rhizopertha* in the 'first milled' rice as against in the 'handpound' calls for some explanation. It is likely that the outer protective layer of cells surrounding the aleurone layer is retained in the handpound rice to a greater extent and is lost in the 'first milled' rice. Exposure of the soft aleurone layer perhaps renders the first milled grains vulnerable to attack by insects more easily than those that have aleurone layer still covered by protective layer of cells.

4. *Pests of cholam (Calndra, Rhizopertha and Tribolium).*— Studies on the storage of cholam in silo were taken up. A preliminary fumigation was given to the silo to ensure it was insect free. Four charges of fumigated grains (492 bags) were stored in silo. Samples of the grains are taken fortnightly to test (1) insect mortality, (2) germination and (3) moisture content and acidity. The Research Engineer is making arrangements for aerating the grains at intervals. Preservation of cholam earheads free from insect attack for purposes of seed was tried by dusting the earheads with *Acorus* powder, *Pyrethrum* powder, *Derris* powder and spraying with kerosene extract of pyrethrum and storing the treated earheads in galvanised iron bins loaned from the Millet Specialist. The results show that *Acorus* and *Pyrethrum* extract afford protection from insects.

5. *Pests of stored wheat.*—In the course of the fumigation of infested Australian wheat, a study was made of the pests. It was found that *Calandra oryzae* and *Rhizopertha dominica* were the most important pests. *Tribolium* was found in small numbers. Studies on the new technique of carbon-dioxide estimation to find out the extent of insect infestation and to judge the effectiveness of fumigation were made.

Pests of stored groundnut (Necrobia, Dermestes, and Ephestia.— Biology of three pests—*Necrobia rufipes, Dermestes cadavarinus* and *Ephestia cautella* was studied. In the first two, both adults and grubs attack the kernels and reduce them to powder; in the case of *Ephestia* the caterpillars do the damage.

A parasite—*Microbracon hebetor*—was found parasitising *Ephestia* caterpillars. The female wasps live for twelve or fourteen days laying on an average of 125 eggs. The eggs hatch in 24 hours and the grubs attain full development in 36 hours. The full grown grubs spin light cocoons, the adult parasites emerging in five to six days.

Five bags each of Coromandel, Khandesh and Pollachi varieties were kept in storage at Cuddalore under warehouse conditions in February 1944 to study their relative susceptibility to insect pests. Samples were drawn from these bags in May; the insects found in one pound sample are given below:—

	Coromandel.	Khandesh.	Pollachi.
Necrobia	4·8	22·6	3·8
Tribolium	22·6	38·6	26·4
Carpophilus	133·0	47·0	54·6

Since only one examination has been completed it is too early to draw any conclusions regarding varietal resistance.

Small-scale trials with a fumigant Chlorosol were conducted. At the rate of ten lb per 1,000 cubic feet and an exposure of 24 hours, it is fatal to the adults and larval stages of *Necrobia* and *Ephestia*. Further trails are in progress. There is

very little insect damage to groundnut when stored in the form of pods even when kept for long periods. So the shorter the interval between decortication and storage, the lesser the chance for the incidence of pests in the stored kernels.

7. *Pests of stored pulses* (*Bruchus analis* and *B. chinensis*) :— Biology of the two important pests of stored pulses—*Bruchus analis* and B. chinensis was studied. Life history studies have shown that Bruchus analis takes 35 days for completion of one generation in December while B, chinensis takes 25 days. The average longevity for B. analis and B. chinensis was ten and five days respectively, the fecundity being 56 and 52 eggs respectively.

Bengal gram imported from North India and kept in large-scale storage in Madras was found infested by a *Dermestid* pest—*Trogoderma granarium*—along with the Bruchids. It was however found to attack only pulses damaged by Bruchids. It is a pest of wheat in the Punjab.

Experiments on the control of Bruchids showed progress. Small scale trials have shown that spreading a one inch layer of sand and oiling the top one inch layer of the grains are effective against the pest. Germination was not affected by oiling. Mixing the pulses with red earth was better than the controls but not so effective as the first two treatments. Further trials are in progress.

V. Studies on Insecticides.

A very important item of work of the section is the study of insecticides—especially indigenous ones. Considerable progress was made in these studies and the results are given under (*a*) indigenous, (*b*) exotic and (*c*) fumigants.

(*a*) *Indigenous insecticides*—(1) *Lobelia excelsa.*—This is a plant growing wild in the Kodaikanals. The leaves were cured and the leaf decoctions were tried against soft bodied insects like aphids, tingids and *Phenococcus* on brinjals and Aphids on snake-gourd with good results. In the hills where it is difficult to get tobacco refuse *Lobelia* should be regarded as a good substitute.

(2) *Cured tops of tobacco.*—Tobacco tops are generally thrown away. Trials made during the year have shown that the decoction prepared from the cured tops of tobacco are effective against Aphis on lab lab. Now that the price of tobacco refuse has increased every endeavour should be made not to waste this source of valuable insecticide.

(3) *Acorus calamus.*—This is yet another indigenous plant whose underground rhizomes possess pronounced insecticidal properties. Like tobacco it can be used both as dust and as infusion. Aqueous extract of Acorus at a strength of one ounce in one gallon of water with the addition of soap was effective

against the brinjal mealy bug. Further trails with Acorus powder have confirmed its usefulness as a preservative for wollen fabrics against the clothes moth and poultry lice.

(4) *Thevetia neriifolia.*—Trials with the kernels of this common hedge plant were continued. Oil emulsion at a strength of one ounce in one gallon of water was tried against mealy bugs and Tingids on brinjal with good results.

(5) *Oil emulsions of castor, neem and groundnut.*—These emulsions at concentrations of ½ and 1 oz. in one gallon of water were effective against *tingids* and mealy bugs on brinjal and *aphis* on cotton.

(*b*) *Exotic insecticides.*—Under this head, *Derris elliptica* received some attention. Roots of this plant are dried and powdered. In the dust form it was effective against brinjal *Tingids*. Water extracts of Derris at one ounce in one gallon of water gave good control when sprayed against *Eupterote* caterpillars on moringa, lablab aphis, mealy bugs and Tingids on brinjal and against adult mosquitoes in an enclosed space. Attempts at the cultivation of Derris in a few centres of this Presidency are proving successful.

(*c*) *Fumigants.*—Due to the difficulty in getting *Calcium Cyanide* and *Carbon-di-sulphide* tests were carried out with two others—*Cymag* and *Chlorosol.* Cymag is a powder which on contact with air produces HCN like Cyanogas. Chlorosol unlike Carbon-di-sulphide is non-inflammable and non-toxic to human life. In the trials carried out, these two gave encouraging results against the stored product pests of cholam.

VI.—Life History Studies and Pest Control Work at Headquarters.

Life history and habits of the insects received from outside and also collected at headquaters were studied. Of the more important insects which were studied, the following may be mentioned:—

(1) *The pulse bruchids—Bruchus analis* and *B. chinensis.*

(2) Tribolium in malt food.

(3) The sweet potato weevil—*Cylas formicarius.*

(4) The Indian mealworm—*Plodia interpunctella.*

(5) *Trogoderma granarium* attacking wheat.

(6) *Cecidomyiad* causing galls on mango leaves.

(7) The cotton aphis and its natural *enemies.*

(8) The pumpkin beetles—*Aulacophora spp.*

(9) Snake gourd pests—*Margaronia* and *Plusia* and their parasites.

(10) *Maruca* in field beans and its parasites.

(11) Parasites of *Epilachna* beetles.

Pests reported from the Central Farm, Orchard, Breeding stations and from villages in the vicinity of the institute received attention. The more important pests dealt with, were aphids on lablab, cluster beans, bhendi and mango flowers; mealy bugs on bhendi; scales on custard apple, sapota and neem; *Parasa* on mango, Eupterote on moringa, the paddy case worm; the castor semi-looper and mites on curry leaf.

VII.—Bee-keeping.

Bee-keeping as a cottage industry is gaining popularity. During the year under review there were 10,267 hives working in this Presidency, the increase over the previous year being 1,598. "The Entomology section of the Agricultural Research Institute has given a practical stimulus which might provide for the expansion of the production and raising of honey bees and production of honey industry in this country", said Rao Bahadur B. Viswanath Garu, Director of Agriculture, Madras, presiding over the seventh Annual Honey Week Celebration organized by the section at Coimbatore on 5 th May 1944.

The apiary at the Institute was a centre of attraction for visitors. An average strength of 40 colonies was maintained throughout the year. From November onwards, colonies began yielding honey. The maximum amount of honey was extracted in December. The maximum record for a hive this year was 12 lb. 12 oz. A total of 157 lb. of honey was extracted from 30 colonies.

Research work on various aspects of bee-keeping was continued.

Bee pasturage.—During the year the following flowering plants were noted for the first time giving pollen or nectar—

Coccinia indica.—Nectar and pollen—November.
Parasa volubiles —Nectar and pollen—November.
Bauhinia anguina.—Nectar—June.

Bee-enemies.—Studies were made on the wasp—*Vespa cincta.* The wasps were active in July, August and December. Foraging activity of the bees is affected due to the presence of the wasps. Application of calcium cyanide to the nests killed all the wasps.

Swarm prevention trials —During the season, the comparative merits of two methods of swarm prevention were studied. The first one was dividing the colonies having queen cells and keeping the divided colony with the old queen a few furlongs away from the original place. The second one was by shifting the parent colony with queen cells a few feet apart and placing a new hive with the old queen along with the two combs in the original place. A swarm preventive trap was devised and preliminary trials have been successful.

Longevity studies.—The maximum longevity of the worker in a colony with queen has been found to be 54 days; the maximum longevity of a queenless colony was however 106 days.

Flight range of bees.—Studies were continued. The distance bees travel due to homing instinct was studied by marking the bees and shifting the colony to different distances. It was found that some of the workers returned to the original place even from a distance of 14 furlongs. Studies during the previous year had shown $8\frac{3}{4}$ furlongs as the maximum distance bees went out for foraging.

Improving the colonies by selection.—The ten selected colonies were under observation. Of these, four continued to show uniform good record and the best of these will be selected for purposes of rearing queens to improve the general condition of the hives.

Propaganda.—To popularize bee-keeping as a cottage industry the section did intensive propaganda. Out of the total of 273 enquiries 110 were received at headquarters. The bee-exhibition held in connexion with the Honey Week Celebration was a great success. A short course in bee-keeping was conducted in February. Under the auspices of the rural recreation organization, classes in bee-keeping were held at different centres in Coimbatore district. Arrangements have been made for giving training for the students of the Government High Elementary Training School, Coimbatore.

VIII.—Fumigation.

The year under report has been a very remarkable one for the large number of fumigations and also large-scale fumigations done by the section. The Government Entomologist was in Madras in July in connexion with the fumigation of 53, 245 bags of infested Australian wheat held by the Commissioner, Civil Supplies. The stock was fumigated in the stationery godown (562,000 cubic feet of space) pumping in 1,700 lb of cyanogas powder. It took ten hours for gassing by means of the gunniting machine with the help of air compressor and 29 hours for de-gassing. This is the first time that such large-scale fumigation has been done in Madras and probably in the whole of India. This work was done in collaboration with the various departments.

Later—in March and April—the Government Entomologist visited Madras and 18,480 bags of infested wheat with the Commissioner of Civil Supplies were fumigated in two lots of 8,870 and 9,660 bags in the stamp godown. Again in Madras 500 bags of tamarind seeds infested with Caryoborus beetle were fumigated for the Buckingham and Carnatic Mills.

At Coimbatore also fumigation work was heavy. Two hundred and twenty-four articles had to be fumigated for the different heads of sections as anti-plague measure. About 500 bags of cholam were fumigated for the Superintendent, Malt Factory. Besides these, the following were fumigated and pest-free certificates issued:—

(1) Three packets of cotton seed for the Cotton Specialist.

(2) Fifty pounds of teak seeds for the Range Officer, Nileshwar.

(3) One pound of Dalbergia seeds for the District Forest Officer, Coimbatore.

(4) Four packets of mustard seeds for the Oil Seeds Specialist.

(5) Two lots of sugarcane material for the Government Sugarcane Expert.

(6) Six samples of plants for Lecturer in Botany.

(7) Four samples of cholam and tenai for Millet Specialist.

IX. Systematics and Collections.

Due to pressure of economic work there was not much time to be devoted for systematic studies. However as time permitted studies on *termites* and *Chalcids* were continued. Though a number of insects have been collected these could not be sent to foreign countries due to war conditions. During the year, two pests unrecorded in this Presidency were intercepted. These were the the granary weevil—*Calandra granaria* and the Khapra beetle—*Trogoderma granarium*. A very dangerous pest of fruit trees—The *San jose scale*—was noted for the first time in Coonoor and Kotagiri.

X. Propaganda and Campaigns.

In Coimbatore and Nilgiris districts, propaganda was done by the headquarters staff; in all other districts, the Entomology-*cum*-Mycology Assistants attended to this work. Demonstrations of remedial measures against pests and popularization of bee-keeping industry formed the major portion of their work. In addition, they were in charge of Pest Act operations and studied insect problems peculair to the tract.

A short account of the work done by the staff is given below :—

Vizagapatam.—The stem borer and gall fly of paddy; mites on sugarcane; *Epilachna, Urentius* and fruit borer on brinjal; the ground nut hairy caterpillar; chillies thrips and aphids on green gram were the pests tackled by the Entomology Assistant at Vizagapatam in addition to popularizing bee-keeping as a cottage industry.

East and West Godavari.—The Entomology Assistant stationed at Samalkot was engaged in the demonstration of remedial measures against pests like *Spodoptera, Hispa* and root grub of paddy; aphids on vegetables; the Coconut caterpillar; chillies thrips and *Bruchids* in stored bengal gram. Bee-keeping showed considerable progress.

Nellore.—The Entomology Assistant at Nellore attended to the control of *Hispa*, leaf roller and stem borer of paddy; citrus borer; the Coconut beetle; red gram *Agromyzid*; chillies thrips; Prodenia on tomatoe, Epilachna and Aphids on brinjals and *Aulocophora* beetle on Cucurbits.

Kurnool and Bellary.—The groundnut hairy caterpillar ; the Deccan grass hopper ; the caster semilooper ; the redgram pod borer ; the mango hopper ; the paddy root weevil ; the cholam mite ; aphids on beans and pests of stored cholam were the more important pests tackled by the Mycology Assistant stationed at Bellary.

Cuddapah and Anantapur.—The Entomology Assistant at Cuddapah demonstrated remedial measures against the swarming caterpillar, case worm, thrips and silver shoot of paddy ; Chloridea caterpillar on gram ; the castor semilooper ; the mango hopper ; Parasa on mango ; Vitellus on citrus, the Coconut beetle ; tobacco aphis, Epilachna and aphids on brinjal. He also made observations on the cattle fly *Stomoxys*.

Chittoor, Chingleput and Madras.—The Entomology Demonstrator stationed at Saidapet attended to the control of the gingelly pests ; Spodoptera, Leptispa, leaf roller and Stem borer of paddy ; Laphygma on ragi ; redgram pod porer ; mites on bhendi, *Epilachna*, Aphids and fruit borer on brinjal. Bee-keeping work also showed progress.

North Arcot, South Arcot and Salem.—The Mycology Demonstrator at Vellore demonstratrd remedial measures against *Aphids* and *Papilio* on citrus ; Aphids on beans, brinjal, peas and cabbage ; the mustard sawfly ; the cabbage bug ; Epilachna on brinjals and stored wheat pests.

Trichinopoly and Tanjore.—Stem borer soorai of paddy ; the coconut beetle and weevil ; the mango hoppers ; the brinjal shoot and fruit borer and Epilachna are some of the major pests tackled by the Assistant Agricultural Demonstrator in Mycology.

Madura, Ramnad, Tinnevelly.—The Mycology Demonstrator stationed at Madura attended to the following pests ; the grape vine flea beetle ; the groudnut hairy caterpillar ; Papilio and Aphids on citrus ; the mango hopper ; the paddy earhead bug ; the cotton leaf roller ; thrips on cardamoms and the white-borer of coffee.

Malabar and South Kanara.—Spodoptera, Hispa, caseworm, leaf folding caterpillar, rats infesting paddy ; aphids on lablab borers on brinjal and the coconut caterpillar were some of the important items of work of the Mycology Demonstrator stationed at Calicut. He also attended to bee-keeping work.

Coimbatore and Nilgiris.—The headquarters staff attended to the following pests ; Prodenia, Semothesa on daincha ; Parasa, Aphis and hopper on mango ; the coconut caterpillar ; the rose chafer ; Scirpophaga on cane ; Cylas on sweet potato ; Epilachna, *Aphis* and *Laphygma* on brinjal ; chillies thips ; *Eupterote* on moringa ; mites on curry leaf and Calandra and *Rhizopertha* affecting stored wheat.

XI. Scientific Papers prepared.

The following papers were prepared during the year :—

(1) On a new species of Cryptotermes from South India.

(2) A note on the identity of Trichogramma evanescens West and T. minutum (Riley).

(3) Studies on the effect of temperature and humidity on the different stages of *Platyedra gossypiella*. Saunders.

(4) Further trials with Trichogramma parasites for the control of the Cotton Bollworms (*Earias* and *Platyedra*) at Coimbatore.

(5) Preliminary studies on the flight range of the Indian bee (*Aphis indica*).

(6) The longevity of the Indian bee (*Aphis indica*).

(7) The fluted scale and its control.

(8) " Hints on bee-keeing " for the months of July to December 1943.

(9) A radio talk on " Paddy grasshopper and its Control ".

(10) A radio talk on " Vegetable insecticides and their uses ".

(11) " Methods of pest control " for publication in Tamil and Telugu journals of the Agricultural Department.

The first six papers were presented before the Indian Science Congress held in January 1944.

XII. War Effort

I acted as Deputy Controller, A.R.P. Organization, Agricultural College. The members of my section also served the organization in other capacities and contributed to the Defence Savings Funds. The last but not the least contribution is the saving of considerable quantities of food grains—especially wheat—to the nation by proper and timely fumigation.

Coimbatore,
10*th August* 1944.

M. C. CHERIAN,
Government Entomologist.

ADMINISTRATION REPORT OF THE GOVERNMENT MYCOLOGIST FOR THE YEAR 1943-44 (FASLI 1353).

1. *Charge.*—I held charge of the office throughout the year.

2. The work of the section is classified and reported on under the following heads:—

I. Research on diseases of food crops.

II. Research on diseases of industrial crops.

III. War efforts and agro-industrial research.

IV. Quarantine services and legislative measures.

V. Propaganda.

VI. Teaching.

VII. Advisory work.

VIII. Microtomy.

IX. Miscellaneous.

I. Research on Diseases of Food crops.

3. *Rice*—Blast disease (*Piricularia oryzae*)—*Varietal resistance—Field trials.*—In an air-borne disease like blast which does not lend itself to fungicidal and other preventive measures the most obvious course is the utilisation of inherent resistance of varieties directly as a means of avoiding the disease and utilizing resistant varieties as parents for evolving disease-resistant hybrid strains. With a view to selecting types for disease resistance, one hundred and fifty cultures comprising long, short and medium duration types were tested under field conditions for their relative susceptibility to the incidence of *Piricularia*. The experiment was laid out in two series in the Central Farm Wetlands, Coimbatore. In the first series the cultures were sown and transplanted at the same time irrespective of their duration, but in the second series they were sorted out into three categories according to their duration, the sowings so arranged that flowering was more or less simultaneous. In both the experiments the varieties were inter-stripped with rows of a highly susceptible variety Adt. 10 and a two-foot belt of this variety surrounded the experimental blocks, in order to provide a source of infection for the experimental cultures. The incidence of the disease was noticed on this variety in the nursery stage itself and after transplanting infection spread to other varieties, the more susceptible cultures being infected earlier than the rest. Periodical observations on leaf, node and neck attack of *Piricularia*

were recorded. The results of the observations are recorded below :—

TABLE I.—*Percentage of incidence of neck attack—Piricularia oryzae in different varieties of rice—Seasonal planting series, 1943–44.*

Serial number and name of variety.	Mean percentage of incidence.	Serial number and name of variety.	Mean percentage of incidence.
1 Co. 13	48·1	57 ADT. 11	13·2
2 PTB. 11	46·8	58 MTU. 8	13·0
3 ADT. 19	46·3	59 MTU. 15	12·0
4 ADT. 3	45·3	60 ADT. 13	12·0
5 PTB. 10	45·1	61 BAM. 6	11·8
6 ADT. 9	43·7	62 ADT. 21	11·4
7 PTB. 1	43·5	63 MTU. 11	11·3
8 PTB. 9	42·4	64 MTU. 12	11·2
9 PTB. 5	41·9	65 3912	11·2
10 PTB. 8	41·5	66 ADT. 22	11·1
11 Co. 21	41·2	67 CO. 17	10·9
12 ADT. 20	39·1	68 CO. 5	10·6
13 PTB. 14	36·6	69 MTU. 7	10·4
14 CO. 9	36·5	70 BAM. 9	10·3
15 ADT. 4	36·4	71 3883	9·7
16 PTB. 2	36·2	72 PTB. 4	9·6
17 ADT. 15	35·9	73 MTU. 5	9·4
18 ADT. 14	35·1	74 ADT. 1	9·0
19 PTB. 13	34·9	75 MTU. 13	8·9
20 MTU. 1	33·1	76 BAM. 10	8·9
21 MTU. 4	32·8	77 CO. 12	8·9
22 CO. 10	32·3	78 6919	8·5
23 CO 20	31·6	79 3919	8·3
24 PTB. 7	30·6	80 ADT. 8	8·0
25 MTU. 2	29·4	81 CO. 6	7·8
26 CO. 18	29·3	82 PTB. 6	7·5
27 ADT. 12	27·7	83 8199	7·1
28 ADT. 10	27·1	84 ADT. 2	7·0
29 MTU. 3	26·8	85 3911	6·8
30 BAM. 3	26·4	86 6918	6·3
31 MTU. 9	25·9	87 8187	6·3
32 CO. 22	25·8	88 MTU. 6	6·1
33 GEB. 24	25·5	89 CO. 16	5·4
34 MTU. 14	25·4	90 4072	5·2
35 PTB. 3	23·75	91 6917	5·2
36 1178	23·6	92 ADT. 7	5·0
37 CO. 2	22·8	93 CO. 4	5·0
38 ADT. 18	22·7	94 ADT. 5	4·8
39 CO. 1	22·3	95 8212	4·5
40 MTU. 10	21·7	96 PTB. 16	3·9
41 BAM. 1	20·7	97 3892	3·7
42 BAM. 2	20·4	98 ADT. 17	3·7
43 CO. 7	20·0	99 8213	3·7
44 PTB. 12	19·5	100 3941	3·3
45 CO. 3	19·3	101 CO. 8	3·2
46 MTU. 16	17·7	102 4070	2·5
47 BAM. 8	17·6	103 ADT. 6	2·3
48 BAM. 7	17·1	104 CO. 15	2·3
49 BAM. 4	16·1	105 4005	2·1
50 8200	15·8	106 CO. 11	1·9
51 1201	14·8	107 8037	1·8
52 CO. 14	14·8	108 4067	1·1
53 CO. 19	14·8	109 3839	0·8
54 ADT. 16	14.7	110 8036	0·1
55 8183	14.4	111 3840	0·2
56 BAM. 5	14·4		

Results—Significant.

Locality—Central Farm wetlands. Critical difference—8·31.
O Block. Date of sowing—28th July 1943.
Layout—Randomised block. Date of transplanting—14th, 15th and 16th September 1943.
Replications—Six.
Standard error—2·99.

TABLE II.—*Percentage of incidence of neck attack—Piricularia oryzae in different varieties of rice, medium duration series.*

Serial number and name of variety.	Mean percentage of neck attack.	Serial number and name of variety.	Mean percentage of neck attack.
1 PTB. 16	4·0	18 MTU. 3	20·2
2 BAM. 3	5·8	19 CO. 1	20·6
3 ADT. 22	6·3	20 8199	21·4
4 BAM. 4	7·9	21 8200	22·0
5 PTB. 6	8·2	22 PTB. 3	22·1
6 PTB. 4	9·0	23 BAM. 1	23·1
7 1178	10·0	24 PTB. 1	24·1
8 1201	10·0	25 PTB. 12	24·3
9 BAM. 2	10·5	26 PTB. 9	24·3
10 MTU. 15	11·5	27 PTB. 13	25·1
11 ADT. 21	11·5	28 PTB. 7	26·1
12 GEB. 24	12·2	29 PTB. 8	28·1
13 PTB. 2	13·8	30 ADT. 18	30·7
14 ADT. 13	14·0	31 PTB. 14	31·0
15 CO. 18	17·4	32 PTB. 5	33·5
16 MTU. 4	18·2	33 PTB. 11	..
17 ADT. 8	19·7		

Results—Significant at 5 per cent.

Layout—Square lattice 6 × 6.
Replications—4.
Standard error—2·87.
Critical difference—8·05.

Date of sowing—25th September 1943.
Date of transplanting—6th November 1943.

TABLE III.—*Percentage of incidence of neck attack—Piricularia oryzae in different varieties of rice—long duration series*, 1943–44.

Serial number and name of variety.	Mean percentage of infection.	Serial number and name of variety.	Mean percentage of infection.
1 MTU. 10	51·1	33 MTU. 6	14·7
2 ADT. 10	42·2	34 BAM. 9	14·2
3 MTU. 13	39·9	35 2588	13·4
4 CO. 2	36·6	36 1984	13·3
5 BAM. 5	35·9	37 ADT. 7	12·9
6 BAM. 7	35·7	38 6917	12·8
7 MTU. 11	35.6	39 BAM. 10	12.3
8 MTU. 1	32·6	40 3911	11·7
9 MTU. 16	32·5	41 3941	11·4
10 ADT. 1	30·0	42 3386	10·3
11 ADT. 2	29·9	43 2465	10·0
12 ADT. 11	29·7	44 CO. 16	9·2
13 CO. 12	29·1	45 2501	9·2
14 MTU. 7	29·0	46 CO. 11	8·9
15 CO. 7	28·9	47 ADT. 6	8·7
16 MTU. 2	28·7	48 CO. 15	8·5
17 BAM. 6	28·0	49 3374	7·8
18 CO. 6	26·3	50 3912	7·8
19 CO. 3	24·2	51 3919	7·8
20 CO, 8	24·1	52 1979	7·4
21 CO· 17	22·9	53 4072	7·0
22 BAM. 8	22·6	54 2202	6·9
23 CO. 14	21·8	55 3458	6·9
24 ADT. 5	21·1	56 3397	6·8
26 CO. 5	21·0	57 8349	6·7
26 CO. 19	17 6	58 2559	6·6
27 MTU. 5	17·1	59 8212	6·5
28 8183	16·8	60 1952	6·3
29 MTU. 8	16·2	61 ADT. 17	5·8
30 MTU. 14	16·1	62 1914	5·8
31 MTU. 12	15·3	63 2566	5.8
32 8187	14·9	64 4070	5·8

Serial number and name of variety.			Mean percentage of infection.	Serial number and name of variety.			Mean percentage of infection.
65	8343	.. ..	5·7	81	CO. 4	.. ..	3·5
66	2486	.. ..	5·4	82	3839	.. ..	3·2
67	6918	.. ..	5·3	83	3820	.. ..	3·1
68	8213	.. ..	5.1	84	2380	.. ..	3·1
69	2488	.. ..	5·0	85	2552	.. ..	3·0
70	3808	.. ..	5·0	86	2554	.. ..	2·9
71	6919	.. ..	5·0	87	8348	.. ..	2·8
72	3342	.. ..	4·8	88	2364	.. ..	2·7
73	3883	.. ..	4·8	89	4005	.. ..	2·6
74	2555	.. ..	4.5	90	3185	.. ..	2·4
75	3892	.. ..	4·4	91	3273	.. ..	2·4
76	8037	.. ..	4·2	92	2366	.. ..	1·9
77	3381	.. ..	3·8	93	3625	.. ..	1·6
78	2507	.. ..	3·8	94	2713	.. ..	1·5
79	4067	.. ..	3·7	95	3840	.. ..	1·5
80	2744	.. ..	3·6	96	8036	.. ..	1·2

Results—Significatn.

Locality—Central Farm wetlands.
Layout—Square lattice 10 × 10.
Replications—4.
Standard error—2·79.
Criticlical difference—7·8.
Date of sowing—28th August 1943.
Date of transplanting—18th and 19th October 1943.

TABLE IV.—*Incidence of* piricularia oryzae *in different varieties of rice in 1943-44—Short duration series.*

Name of variety.			Percentage of incidence.	Name of variety.			Percentage of incidence.
1 CO. 9	.. ..		27·1	9 MTU. 9	.. ..		18·4
2 ADT. 14	.. ..		25·4	10 CO. 10	.. ..		18·0
3 ADT. 9	.. ..		23·4	11 ADT. 4	.. ..		17·1
4 PTB. 10	.. ..		23·2	12 CO. 22	.. ..		15·6
5 ADT. 19	.. ..		23·0	13 ADT, 15	.. ..		15·3
6 CO. 21	.. ..		21·5	14 ADT. 12	.. ..		10·9
7 CO. 13	.. ..		19·4	15 ADT, 20	.. ..		10·3
8 CO. 20	.. ..		18·9	16 ADT. 16	.. ..		9·2

Results—Not significant.

Locality—Central Farm wetlands.
Layout—Square lattice.
Replications—4.
Standared error—2.79.
Critical difference—7·8.
Date of sowing—28th August 1943.
Date of transplanting—18th and 19th October 1943.

4. *Rice* (Foot rot) (*Fusarium moniliforme* var. *Majus*).—(*a*) *Varietal resistance—Field experiments.*—Forty-eight cultures of rice were tested for their relative susceptibility to foot-rot infection which manifests itself predominantly in the nursery. The experiment was carried out in two series in the Central Farm, Coimbatore. In the first series twenty-nine varieties were tested early in the season and the second series besides ten varieties which showed conspicuous resistance in the first series nineteen new varieties were tested. Seed artificially infected with viable spores of a proved pathogenic stain of the fungus was sown in the nursery in randomised blocks replicated four times. periodical counts of mortality of seedling were recorded and the evaluation of resistance was based on the percentage of disease incidence in the different varieties in relation to the incidence in a known susceptible variety which served as control.

TABLE V.—*Incidence of 'Foot rot' of rice* –Fusarium moniliforme *var Majus in different varieties of paddy in 1943-44— First experiment.*

Name of variety.	Percentage of infection.	Name of variety.	Percentage of infection.
1 CO, 10	81·18	16 MTU. 14	21·18
2 CO. 4	66·75	17 BAM. 6	19·48
3 MTU. 15	56·78	18 MTU. 16	19·1
4 BAM. 4	54·48	19 BAM. 10	18.93
5 MTU. 9	52·1	20 BAM. 3	10·58
6 MTU. 6	51·28	21 BAM. 7	9·48
7 BAM. 1	49·48	22 MTU. 1	9·33
8 MTU. 4	47·65	23 MTU. 5	9·1
9 BAM. 2	42·95	24 BAM. 9	8·48
10 BAM. 5	41·65	25 MTU. 13	2·98
11 MTU. 11	41·43	26 MTU. 2	2·65
12 MTU. 3	38·5	27 MTU. 8	2·53
13 MTU. 7	37·05	28 MTU. 10	1·55
14 MTU. 12	34·23	29 GEB. 24	0·25
15 BAM. 8	28·55		

Results—Significant at 5 per cent level.

Standard error—3·92. Sown on 30th October 1943.
Critical difference—11·03.

TABLE VI.—*Percentage of incidence of Foot rot on different varieties of paddy in 1943–44 (Second experiment).*

Serial number and name of variety.	Percentage of infection.	Serial number and name of variety.	Persentage of infection.
1 CO. 3	56·15	16 CO. 14	7·15
2 CO. 21	51·60	17 CO. 16	6.77
3 CO. 13	37·3	18 MTU. 5	5.95
4 CO. 2	33·92	19 CO. 19	5·8
5 CO. 8	33·75	20 CO. 9	5·02
6 CO. 5	32·45	21 BAM. 7	4·22
7 CO· 18	29 55	22 MTU. 13	4·07
8 CO. 6	21.77	23 MTU. 1	3·57
9 CO. 20	19·77	24 MTU. 2	3·22
10 CO. 7	15·72	25 CO. 1	3·02
11 CO. 17	13·15	26 GEB. 24	2·97
12 CO. 12	13·00	27 CO. 15	2·22
13 BAM. 9	11·8	28 MTU. 10	2·2
14 CO. 11	9·37	29 MTU. 8	1·45
15 BAM· 3	7·57		

Standard error—4.79. Date of sowing—5th January 1944.
Critical difference—13·48.

The following varieties showed high resistance in both the series: GEB. 24; MTU. 8; MTU. 10; MTU. 2; MTU. 13; BAM. 7; and BAM.3.

(*b*) *Fungicidal trials.—Field experiments.*—The disease is seed borne and is controlled by seed treatments with fungicides. An experiment was laid out to test the relative efficacy of 19 fungicides which included six organo-mercury preparations made in the Chemical Research Laboratories of the Andhra University. Seed of a highly susceptible variety, viz., CO.10 was artificially infected with viable spores, and then treated with the fungicides before sowing. The treated seeds were sown in randomised blocks replicated five times. Mortality counts were periodically taken, and the

results evaluated on the basis of the percentage of infection in relation to the control (untreated seed) which showed 86·58 per cent infection.

TABLE VII.—*The effect of seed treatment with fungicides on the incidence of Foot rot* (F. moniliforme *var* Majus) *1943–44.*

Treatment.	Percentage of infection.	Treatment.	Percentage of infection.
J Control	86·58	P Seshadri compound IV.	4·0
K Peronox	44·66	N Seshadri compound II.	2·98
L Sherlon N.A. ..	26·14	M Seshadri compound I.	2·84
B Tillantin.	19·9	Q Seshadri compound V.	1·9
O Seshadri compound III.	16·14	D Germisan.	1·88
R Seshadri compound VI.	11·12	E Ceresan Nazbeize ..	1·1
H 3399/9N	9·74	L Agrosan G	0·78
S Formalin charcoal dust.	8·8	F Granosan.	0·74
A Semesan Jr.	7·24	G Uspulun.	0·34
C Semesan.	5·08	J Ceresan.	0·22

Significant at 5 per cent level.
Standard error—3·33.
Critical difference—9·35

Variety of rice—CO.10.
Sown on—15th November 1943.

5. *Ragi blast* (*Piricularia eleuoinae*)—***Field experiments.***—The investigation of the disease was continued. Twenty-one cultures of ragi were tested under field conditions for their relative susceptibility to 'blast' incidence. The trials were carried out in three seasonal series, transplanting being done in July, September and October, respectively. The incidence of the disease in the July planted crop was negligible in all the varieties tested. In the two late planted crops the incidence was of modrate intensity only, the highest percentage recorded being 29 in the September planted crop and 27·1 in the October planted crop in any variety. E.C. 155 showed a commendable degree of resistance in both the late planted series consistently. All the other varieties were found to be susceptible to the disease to a greater or less degree in one or the other series. From the results of the experiments carried out so far in respect of ragi blast it is found that under conditions obtaining in Comibatore the crop escapes infection if transplanted in July, but it is liable to be attacked by the disease if transplanted later, the intensity of incidence being dependent on weather conditions prevalent at the time.

6. *Sorghum 'grain smut'* (*Sphacelotheca sorghi*).—Owing to the difficulty experienced in procuring supplies of ground sulphur for seed dressing against sorghum smut, the search for alternative methods of control was necessitated, and a series of experiments were laid out with a view to find out suitable measures. In this series was included the trial of the method advocated by Professor Luthra of the Punjab, viz., soaking the seeds in water for four hours, and drying them in shade in order to induce the smut spores adhering

to the surface to germinate and perish before the seed is sown in the soil, avoiding infection thereby. This method is a modified form of the method advocated by the Burma Department of Agriculture, which, it has been stated was found somewhat successful in Burma. It must be stated, however, that both the methods are time consuming and laborious, and can at best be recommended only when sulphur or copper sulphate is unavailable.

Experiment I.—The object of the experiment was to test the efficacy of (1) Burma method and (2) Professor Luthra's modified Burma method in comparison with the standard sulphur treatment. Seed of a susceptible variety was artificially infected with viable smut spores and was subjected to the following treatments before sowing:—

(1) Seed soaked in cold water for four hours and then allowed to dry in the shade till thoroughly dry, (2) seed soaked in cold water for four hours and then allowed to dry in the sun, (3) seed treated with ground sulphur (200 mesh) at the rate of one ounce per 15 lb. of seed (standard treatment), (4) control (seeds untreated). The treated seed was sown in dry land in randomized blocks replicated five times. The experiment failed to give conclusive results owing to the absence of the disease even in the control plots.

Experiment II.—The same experiment was repeated in miniature plots, sowings being done every month from July 1943 to January 1944 and the plots being irrigated. The incidence of the disease was negligible in all but the January sown crop. In the January sown crop the results were as follows: Control showed 20 per cent infection, Burma method 7 per cent; sulphur nil and modified Burma method (Prof. Luthra's) nil.

Experiment III.—The experiment was repeated in an irrigated field, and periodical irrigations were given. Four strains of cholam AS. 732, AS. 1543, AS. 809 and AS. 2095 were included in the trial and seeds of these varieties were artificially infected and subjected to the various treatments as in Experiment I. The seed was sown in randomized blocks replicated six times.

The incidence of the disease in all the plots was too low and erratic to gauge the relative efficacy of the treatments tried, and the results were not significant. In this connexion it may be mentioned that the incidence of disease is governed largely by environmental factors such as soil temperature at the time of sowing. The very low incidence of disease in the experimental plots including the controls in which heavily infected seed was sown is attributable to the conditions being unfavourable for infection during the season. The experiment has, however, indicated that even if the method proves successful, the soaking of large quantities of seed in water for four hours and then drying it in the shade is laborious and this method of treatment may not find favour with ryots who have to manage large areas as is the case in the Ceded districts where the sowing has to be done within the space of a day

or two after the receipt of the sowing rains. The germination capacity of the seed was not adversely affected by any of the treatments, even when the treated seeds were kept in storage for two months after treat ments, but the chances of reinfection from containers like gunnies exist in the case of water treatment.

Experiment IV.—The object of the experiment was to see if any reduction in the quantity of sulphur used for seed dressing could be made without detriment to its fungicidal efficacy. The usual dosage is one ounce of sulphur for every 15 lb. of seed, and as a preliminary step for carrying out field trials, laboratory trials were made with two-thirds and half the quantity of sulphur. It was found that while the usual standard quantity completely inhibited the germination of smut spores adhering to seed, the reduced dosages were not so effective, nearly 10 per cent of the spores remaining viable.

7, *Sorghum striga.*—Two field experiments were carried out in connexion with the control of the plant parasite *Striga lutea.*

Experiment I—Trap crops.—The object of the experiment was to test the efficacy of raising a trap crop in order to induce germination of the striga seed in the soil and thus eliminate it. Recent work in South Africa has shown that besides cereals, crops such as groundnut are also capable of inducing striga seed to germinate. The following seven treatments were included :—

(1) Growing maize and pulling out the striga plants on emergence.

(2) Growing maize and ploughing it in with the striga plant.

(3) Growing sorghum and pulling out the striga plants on emergence.

(4) Growing sorghum and ploughing it in as in (2).

(5) Growing groundnut and ploughing it in.

(6) Treatment with a weedicide.

(7) Control (no treatment).

The experiment was laid out in randomized blocks replicated four times. A subsequent crop of sorghum (var. *peria manjal cholam*) was raised and the incidence of striga in the plots was recorded. The results of the experiment were not significant.

Experiment II—Cultural practices.—Ryots in Coimbatore believe that the incidence of the parasite is greater in a sorghum crop raised on a land ploughed in a dry state than when raised on land ploughed in a wet condition. In order to find out if there is a basis for this belief an experiment was laid out in a dry land field in which a heavy incidence of striga was noticed in the previous season. The field was divided into twelve plots of equal size, and in six plots the land was ploughed immedialely after the rains before the moisture was lost, and in six plots the land

was ploughed when it was wet. A crop of *periamanjal cholam* was raised in the field and the incidence of striga was recorded for each plot. The results of the experiment were not statistically significant.

	Mean incidence of striga per plot.
Dry ploughing series	53
Wet ploughing series	41

Results—Not significant.

8. *Wheat 'rusts'.*—Though wheat is not a crop of importance in the Province, the section collaborated in an All-India scheme of rust control in (1) the suspension of the first crop of wheat and barley (April to September) in the Nilgiris and Pulney Hills, (2) estimating the incidence and destructiveness of rusts in the cold weather crops of wheat and barley.

(1) *Suspension of the first crop of wheat and barley.*—With the aid of the Madras Agricultural Pests and Diseases Act, suspension of wheat and barley crops was enforced between April and September in the Nilgiris and Pulneys. The administration of the Act was in charge of the District Agricultural Officers, Nilgiris and Mathurai, respectively. Except for a few stray cases of surreptitious sowings no wheat or barley crop was sown during the prohibited period either in the Nilgiris or Pulneys.

12. *Estimating the incidence and destructiveness of rusts in the cold weather crops of wheat and barley.*—An assistant appointed specially for the purpose toured the districts and recorded the incidence of rusts in the cold weather crop. In the 1943–44 season, the results of his observations are as follows :—

(*a*) The wheat and barley crops in the hills showed infection of black rust only late in the season, but the brown rust appeared earlier. The respective dates on which these rusts were first noticed were as follows.

(*b*) In the plains, the incidence of rust was noticed in Coimbatore, Chitaldrug, Mandya, Mysore and Bellary early in the season. The dates on which infection was noticed were as follows :—

TABLE VIII.—*Incidence of wheat rust in the Madras Presidency.*

Place.	Earliest recorded date of appearance of rust.		
	Black.	Brown.	Yellow.
Plains—			
Chitaldrug (Mysore) ..	11th December 1943.	..	..
Bellary (Madras) ..	15th December 1943.	15th December 1943.	..
Coimbatore (Madras) ..	21st January 1944.	4th January 1944.	..
Mandya (Mysore) ..	..	2nd Feburary 1944.	
Hills (Nilgiris) (Madras)—			
Nanjanad (Madras) ..	31st March 1944.	..	..

Place.	Earliest recorded date of appearance of rust.		
	Black.	Brown.	Yellow.
Hills (Nilgiris) (Madras)—*cont.*			
Jagathala (Madras) ..	..	23rd December 1943.	..
Santhur (Madras) ..	..	..	8th March 1944.
(Pulneys)—			..
Shembaganur (Madras).	11th March 1944.	..	
Poombarai (Madras).	..	17th January 1944.	17th January 1944.
Kodaikanal (Madras) ..	13th March 1944.	..	..
Devikulam (Travancore)—			
Vattavada (Travancore).	..	11th January 1944.	11th January 1944.

Miniature plots of wheat varieties, barley and oats were raised every month at Coimbatore from June onwards. Black rust made its first appearance on 21st January 1944 and brown rust was observed on the 4th January. An experiment was started to see if the rust spores of black and brown rusts could over-summer under Coimbatore conditions and is in progress.

9. *Red gram 'wilt' Fusarium udum*: *Field experiments on varietal resistance.*—The experiments were continued. Ninety-three cultures of redgram including the progeny of crosses made with resistant varieties like Pusa 80 and Thadagam selections were tested under field conditions, by growing them in a heavily infected soil. The relative resistance of the varieties was evaluated in relation to the incidence in a highly susceptible variety—1723. The incidence in this variety was high, indicating that the results obtained during the year could be relied on.

TABLE IX.—*Percentage of incidence of 'will' in varieties of redgram*, Set I.

	Name of variety.		Percentage of wilt.		Name of variety.		Percentage of wilt.
1	P3 × 2013	78 ..	5·1	13	P3 × 2013	75 ..	11·5
2	,,	321 ..	5·6	14	,,	120 ..	11·9
3	,,	68 ..	6·8	15	,,	162 ..	12·3
4	,,	231 ..	7·4	16	,,	311 ..	12·7
5	,,	187 ..	7·5	17	,,	77 ..	15·0
6	,,	242 ..	7·8	18	2058/2	61 ..	19·9
7	,,	173 ..	9·5	19	P3 × 2013	118 ..	19·9
8	,,	180 ..	10·1	20	,,	30 ..	20·4
9	,,	40 ..	10·2	21	P2 × B5	35 ..	31·4
10	,,	119 ..	10·3	22	P3 × 2013	230 ..	32·1
11	,,	90 ..	9·6	23	P2 × B5	5 ..	39·9
12	,,	199 ..	11·0	24	Control	(1723) ..	96·3

Locality—Field No. 7, Cotton Breeding Station.
Lay out—Randomized block.
Replications—Six.
Results.—Significant.
Standard error—4·22.
Critical difference—11·78.

Set II.

	Name of variety.		Percentage of wilt.		Name of variety.		Percentage of wilt.
1	P3 × 2013	202	1.3	19	P3 × 2013	113	9.4
2	,,	150	1.4	20	,,	41	9.4
3	,,	88	2.1	21	,,	67	10.3
4	,,	214	3.2	22	,,	129	11.0
5	,,	127	3.3	23	,,	135	11.3
6	,,	18	3.3	24	,,	262	11.6
7	,,	257	3·5	25	,,	92	11.8
8	,,	204	4.9	26	,,	206	13.0
9	,,	159	4.9	27	,,	71	13.0
10	,,	167	5·1	28	,,	60	13.2
11	,,	201	5·9	29	,,	23	15.1
12	,,	133	5·6	30	,,	124	15.8
13	,,	32	6·3	31	,,	114	15.9
14	,,	37	6·7	32	,,	241	16.0
15	,,	66	7·4	33	,,	69	16.8
16	,,	216	8·9	34	,,	56	29.7
17	,,	42	9·2	35	,,	106	32.6
18	,,	141	9·1	36	Control	..	96.1

Locality—Field No. 7, Cotton Breeding Station.
Lay out—Randomized blocks.
Replications—Four.
Results—Significant.
Standard error—4·21.
Critical difference—11·76.

Set III.

	Name of variety.		Percentage of wilt.		Name of variety.		Percentage of wilt.
1	P3 × 2013	267	5.5	19	Tadagam	14	27.1
2	,,	287	5.7	20	P2 × B5	44	27.5
3	,,	312	5.7	21	Tadagam	10	29.2
4	,,	272	6.3	22	,,	4	30.3
5	,,	318	6.7	23	P3 × 2013	319	31.1
6	,,	269	7.1	24	2829	24	31.9
7	,,	334	10.4	25	Tadagam	11	34.2
8	P2 × B5	4	10.6	26	2829	13	35.1
9	P3 × 2013	278	10.9	27	P2 × B5	1	39.4
10	B5 × P2	6	11.1	28	Tadagam	5	39.7
11	2058/2	22	14.5	29	,,	18	43.7
12	P3 × 2013	329	15.2	30	P3 × 2013	286	47.3
13	2058/2	37	15.2	31	Tadagam	17	48.0
14	P3 × 2013	279	17.2	32	,,	16	52.2
15	,,	324	19.6	33	,,	9	54.1
16	2058/2	57	21.6	34	,,	2	63.8
17	B5 × P2	22	24.4	35	2058/2	20	64.2
18	2058/2	54	26.4	36	Control (1723)		95.8

Locality—Field No. 7, Cotton Breeding Station.
Lay out—Randomized blocks.
Replications—Four.
Results—Significant.
Standard error—3·32.
Critical difference—9·27.

10. *Orange 'Mottle leaf'—Deficiency disease.*—The experiments laid out at Panyam (Kurnool district), Kodur (Cuddapah district) and Yercaud (Salem district) in connexion with the investigation of mottle leaf disease of citrus were continued, and periodical observations were recorded in the experimental gardens. Previous years' results have shown that treatment with zinc sulphate is effective in controlling the disease and that the best form of application of the chemical is by spraying a neutral solution of zinc sulphate on the foliage. Observations recorded during the year showed that the efficacy of the treatment is not permanent and

periodical sprayings are necessary to prevent the trees reverting to a diseased condition. Zinc sulphate applied to the soil was not effective in controlling the disease.

The treatments tried during the year were as follows :—

(*A*) *Spray treatments.*—One per cent solution of—

(1) Zinc sulphate.lime mixture.
(2) Magnesium sulphate-lime mixture.
(3) Ferrous sulphate-lime mixture.
(4) Copper sulphate-lime mixture.
(5) Combination of all salts.

(*B*) *Soil treatments.*—(1) Zinc sulphate, (2) magnesium sulphate, (3) iron sulphate and (4) lime.

II. Research on Diseases of Industrial Crops.

11. *Cotton—Black arm—Phytomonas malvacearum.*—The disease has been noticed, so far to cause damage to exotic cottons only, though stray cases of infection in Karunganni has been occasionally observed. The disease is primarily seed-borne affecting seedlings, and secondary infection when it occurs affects the foliage and bolls. Experiments carried out in previous years have shown that primary infection could be effectively checked by treating the seed with fungicides. An experiment carried out during the year to test the efficacy of various fungicides in controlling seed-borne infection did not, however, give significant results.

Table X.—*Relative efficacy of fungicides in the control of black arm of cotton.*

Treatment.	Percentage of incidence.
1 Formalin steep 1/100 for 10 minutes	6.76
2 Formalin spray 1 lb. for 100 lb. of seed	13.94
3 Formalin dust 1·5 gm. per lb. of seed	13.44
4 Ceresan 1 gm. per lb	13.40
5 Agrosan G 1 gm. per lb.	12.8
6 N. G. 3399/9N 1 gm. per lb.	19.1
7 Semesan 1 gm. per lb.	4·8
8 Control (No treatment)	8.1

Results—Not significant.
Locality—Cotton Breeding Station, Coimbatore.
Lay out—Randomized blocks.
Replications—Five.
Variety—Co. 4.

12. *Tobacco—Broom rape—Orobanche cernua* var. *desertorum.*—The occurrence of the parasite in the districts of Guntur and East and West Godavari is a serious menace to the successful growing of tobacco, and a series of experiments were carried out to find out practicable and economic methods of control at the Agricultural Research Station, Lam, Guntur, under a special scheme of research financed by Government in G.O. Ms. No. 1968, Development, dated 19th September 1942.

Experiment I.—The application of dried and powdered sunflower material to the soil at 30 tons per acre has been reported to be successful in reducing the incidence of *Orobanche cernua*, race B on sunflower in Russia (Rostov on Don). It was stated that the material exerted a stimulating effect on the germination of orobanche seed, which subsequently perished for want of a host plant. An experiment was laid out, to find out if the method could be utilized in South India with advantage. The experiment was carried out in pots as well as in field, and the field experiment was laid out in two different places.

(1) *Field experiment.*—

Object.—To test if the application of sunflower or *Pillipesara* organic matter to the soil controls or reduces the incidence of orobanche on tobacco.

Treatments.—A. Sunflower grown *in situ*, cut and incorporated in the soil one month prior to planting of tobacco.

B. Sunflower material dried, cut and incorporated in the soil at the rate of 32 tons per acre one month prior to planting of tobacco.

C. An equivalent amount of *Pillipesara* (*Phaseolus trilobus*) organic matter applied to the soil.

D. No treatment.

The experiment was laid out in a heavily infested soil.

Lay out—Randomized blocks.

Replications—six.

Area of each plot—1·25 acres.

Date of application of organic matter—4th October 1943.

Date of planting tobacco—4th November 1943.

The emergence of orobanche was recorded periodically and the first emergence was noticed on 17th December 1943.

TABLE XI (A).—*Summary of results—Experiments at Agricultural Research Station, Lam.*

Treatment.	Sun flower grown *in situ*.	Sun-flower raised outside the plot.	Pilli-pesara raised outside the plot.	Control.	Mean.	Standard error.	Critical difference.
Mean number of orobanche shoots.	20·8	68·8	129·5	70·0	72·3	33·61	71·62
Mean yield of tobacco leaves in pounds.	134·8	295·1	300·7	288·1	254·7	25·88	55·14

Conclusion.	Pillipesara.	Control	Sunflower raised outside the plots.	Sunflower grown *in situ*.
1 Incidence of orobanche shoots.	129·5	70·0	68·8	20·8

	Pillipesara.	Sunflower raised outside the plot.	Control.	Sunflower grown *in situ*.
2 Yield of tobacco	300·7	295·1	288·1	134·8

The results show that while sunflower grown *in situ* tends to reduce the incidence of orobanche it affects the yield of tobacco grown subsequently and therefore the method of control is not to be recommended.

TABLE XI (B)—*Experiment in a ryot's field.*

Treatment.	Sunflower grown *in situ*.	Sunflower raised outside the plot.	Pillipesara raised outside the plot.	Control.	Mean.	Standard error.	Critical difference.
1 Mean number of shoots pulled per plot.	13·2	74·2	58·7	15·7	40·42	18·3	36·6
2 Mean yield of tobacco leaves in pounds.	5·58	9·72	8·92	8·72	8·23	1·35	2·88

Conclusion.	Sunflower raised outside the plot.	Pillipesara.	Control.	Sunflower grown *in situ*.
1 Incidence of orobanche shoots.	74·2	58·2	15·7	13·2
2 Yield of tobacco in lb.	9·72	8·92	8·72	5·58

The incidence of orobanche is lowest in plots where sunflower was grown *in situ*, but the yield is also significantly reduced, as in (A).

Experiment II—Pot experiments.—The object of the pot experiments was (1) to compare the effect of application of different levels of (*a*) sunflower material cut, dried and applied to orobanche infested soil and (*b*) other organic matter *pillipesara*—(*Phaseolus trilobus*) cut, dried and applied to the soil, on the incidence of orobanche.

(2) To ascertain the interval that should elapse between the date of application of the organic matter and planting of tobacco in order that the treatment may be effective. Duplicate expreiments were carried out at Guntur and Coimbatore. Two hundred and forty earthenware pots were filled with 20 lb. of heavily infested soil, and the materials for the various treatments were well mixed with the soil in the levels mentioned below and on dates corresponding to two, three, four, five and six fortnights before the date fixed for transplanting tobacco. After treatment, the pots were kept moistened till the date of transplanting. Tobacco was planted on 16th October 1943 and counts of orobanche incidence were recorded perodically till the tobacco plants reached maturity.

TABLE XII.—*Scheme of pot experiments on the effect of sunflower and other organic matter on the germination of orobanche seed in infested soil.*

Serial number and interval between planting and application of material.	A			B			Control.
	Sunflower material per kilogram of soil.			Pillipesara material per kilogram of soil.			
	30 gm.	45 gm.	60 gm.	30 gm.	45 gm.	60 gm.	
1 Two fortnights.	7 pots.	7 pots.	7 pots.	7 pots.	7 pots.	7 pots.	7 pots.
2 Three ,,	7 ,,	7 ,,	7 ,,	7 ,,	7 ,,	7 ,,	7 ,,
3 Four ,,	7 ,,	7 ,,	7 ,,	7 ,,	7 ,,	7 ,,	7 ,,
4 Five ,,	7 ,,	7 ,,	7 ,,	7 ,,	7 ,,	7 ,,	7 ,,
5 Six ,,	7 ,,	7 ,,	7 ,,	7 ,,	7 ,,	7 ,,	7 ,,
Total ..	35	35	35	35	35	35	35

The results of the experiment did not give indication that the application of organic matter, either sunflower or *pillipesara* will be effective in reducing the incidence of orobanche in heavily infested soils. The stimulating effect of these materials was, however, in evidence, the control pots showing least emergence in four out of the five fortnightly series, and in the aggregate.

TABLE XIII.—*Germination of orobanche seed in infested soil in relation to the application on sunflower and other organic matter.*

Interval between incorporation of organic matter and planting tobacco.	A			B			Control.	Mean.	Standard error.	Critical difference.	Significance.
	Sunflower organic matter.			Pillipesara organic matter.							
	30 gm.	45 gm.	60 gm.	30 gm.	45 gm.	60 gm.					
Two fortnight	38·4	64·9	60·9	77·0	104·9	124·1	30·0	71·4	10·14	20·69	Yes.
Three ,, ...	33·0	59·4	46·9	62·6	80·7	95·0	26 0	57·7	9·02	18·31	Yes.
Four ,, ...	38·4	51·9	72·3	55·3	87·4	115·1	25·4	64·6	8·74	17·74	Yes.
Five ,, ...	34·3	50·1	57·6	82·6	80·1	82·4	37 0	60·6	9·36	19·00	Yes.
Six ,, ...	54·3	70·3	91·7	73·6	83·3	104·6	52·1	75·7	10·23	20·77	Yes.
On the aggregate	277·4	423·6	461·0	491·4	611·0	729·8	238·8	461·9	38·87	80·11	Yes.

Summary.

Two fortnights ..	B. 60	B. 45	B. 30	A. 45	A. 60	A. 30	Control.
Three ,, ..	B. 60	B. 45	B. 30	A. 45	A. 60	A. 30	Control.
Four ,, ..	B. 60	B. 45	A. 60	A. 45	B. 30	A. 30	Control.
Five ,, ..	B. 30	B. 60	B. 45	A. 60	A. 45	Control.	A. 30.
Six ,, ..	B. 60	A. 60	B. 45	B. 30	A. 45	A. 30	Control.
On the aggregate ..	B. 60	B. 45	B. 30	A. 60	A. 45	A. 30	Control.
..	..	..	..	..	..	..	..
	729·8	611·0	491·4	461·0	423·6	277·4	238·8

Experiment III.—The experiments were carried out in two places—Guntur and Coimbatore.

Tobacco was planted in potted soil used in the previous year, and the incidence of orobanche was recorded. At Guntur there was profuse emergence of orobanche in all the pots without any significant difference between the treatments showing that the application of sunflower has had no beneficial effect even after one year, and therefore the method cannot be said to be suitable for adopotion at Guntur.

At Coimbatore, however, the results of the experiment showed that the application of 30 to 45 grammes of sunflower to the soil significantly reduces the incidence of orobanche, while all the other treatments, viz., 60 grammes of sunflower, 30, 45 and 60 grammes of other organic matter were not superior to control.

TABLE XIV.—*Incidence of orobanche in pots treated in* 1942–43 *with sunflower and sunhemp at various levels.*

Treatments.	Number of orobanche shoots.
Sunflower 30 gms.	42
,, 45 ,, ...	47
,, 60 ,, ...	80
Sunnhemp 30 ,, ...	108
,, 45 ,, ...	122
,, 60 ,, ...	72
Control	97

Mean—81·1.
Standard error—2·245.
Critical diference—6·41.
Results—Significant.

Experiment IV—Experiment for the control of orobanche by incorporating roots, stems and leaves of tobacco and other solanaceous plants.—The object of the experiment was to find out if the application of organic material of solanaceous plants including tobacco to the soil induce the germination of orobanche seed in the absence of a suitable host plant, with the result that they will subsequently perish after germination. The experiment was carried out in pots with seven replications. The organic matter, roots, stems and leaves were applied in two series in respect of each solanaceous plant included in the trials. In series 1 the material was applied fresh and in series 2 the material was dried, powdered and then applied. The following are the treatments: (1) Brinjal organic matter (fresh and dry), (2) *Datura fastuosa* (fresh and dry), (3) tobacco organic matter (fresh and dry), (5) Tomato organic matter (fresh and dry), (6) Sunflower organic matter (fresh and dry), (7) No treatment (6 and 7 being controls).

Pots were filled with weighed quantity of soil (20 lb.) got from a field known to be heavily infested with orobanche in previous years. To make sure of the presence of infected material 1 gramme of fresh seed of orobanche was added to each pot. The organic matter was chopped and applied to the soil on 16th November 1943 at the rate of 60 grammes per kilogram of soil. The pots were kept moistened for 6 weeks. Tobacco was planted on 31st December 1943 and the incidence of orobanche was recorded.

TABLE XV.—*Incidence of orobanche under various treatments.*

Serial number and treatments.	Mean number of orobanche shoots.
1 Brinjal (fresh)	69·6
2 Brinjal (dry)	93·3
3 *Datura fastuosa* (fresh)	39·3
4 *Datura fastuosa* (dry)	38·6
5 Tobacco (fresh)	40·0
6 Tobacco (dry)	53·1
7 Tomato (fresh)	53·7
8 Tomato (dry)	56·7
9 Sunflower (fresh)	41·1
10 Sunflower (dry)	54·6
11 No treatment	38·6

Standard error—10·09.
Critical difference—20·18.
Results—Significant.

Conclusions—

(2)	(1)	(8)	(10)	(7)	(6)	(9)	(5)	(3)	(4)	(11)
93·3	69·6	56·7	54·6	53·7	53·1	41·1	40·0	39·3	38·6	38·6

It will be seen that control shows least emergence, the application of brinjal organic matter in a dry state the highest emergence and that the application of organic matter generally increases the incidence of orobanche.

The yield data for the above experiment, however, show that the application of organic matter in dry form is beneficial in increasing the yield of leaves.

TABLE XVI.—*Yield (Weight of green leaves) consequent on application of organic matter of various plants.*

Serial number and treatment.	Weight in ounces.
1 Brinjal (fresh)	14·1
2 „ (dry)	20·3
3 *Datura fastuosa* (fresh)	14·0
4 „ „ (dry)	28·3
Sunflower (fresh)	9·4
„ (dry)	13·1

Serial number and treatment.	Weight in ounces.
7 Tobacco (fresh)	7·1
8 „ (dry)	19·6
9 Tomato (fresh)	9·1
10 „ (dry)	15·9
11 Control	6·6

Standard error—1·75.

Critical difference—3·5.

Results—Significant.

Conclusions—

(4)	(2)	(8)	(10)	(1)	(3)	(6)	(5)	(9)	(7)	(11)
28·3	20·3	19·6	15·9	14·1	14·0	13·1	9·4	9·1	7·1	6·6

(1) Control has given the lowest yield and *Datura fastuosa* the highest yield and (2) The application of any organic matter in the dry state is more beneficial than its application in its green state.

Experiment V— Chemical versus *mechanical methods of control of orobanche cernua on tobacco.*—The object of the experiment was to find out if the application of solutions of copper sulphate, ferrous sulphate, combination of copper and ferrous sulphates and Agri tree killer will be effective in destroying broom rapes without adversely affecting the host plant, and to compare the efficacy of this method with the method now advocated, namely hand-picking of rapes for the eradication of the parasite. The experiment was carried out in duplicate, one in the Guntur Lam Farm and another in a royt's field nearby. The incidence of orobanche in the Government Farm was negligible. In the royt's field, the incidence was high and the results are furnished below :—

TABLE XVII.—(*a*) *Incidence of orobanche* (*total number of rapes removed*).

Number and treatments.	Mean number of rapes per plot.
1 Hand-picking every day	171·75
2 Hand-picking every alternative day.	288·25
3 Hand-picking once in three days	209·75
4 Hand-picking once a week	209·00
5 Control	44·5

Standard error—84·2.

Significance—Not significant.

Number and treatment.	Mean number of rapes per plot.
1 Copper sulphate and ferrous sulphate solution	24·0
2 Copper sulphate solution	23·8
3 Ferrous sulphate solution	35·5
4 Agri tree-killer	19·3
5 Control	44·5

Standard error—11·07.
Significance—Not significant.
Locality—Guntur.
Layout and replications—Randomized blocks replicated four times.
Area of each plot—0·69 cent.
Date of planting tobacco—6th November 1943.

TABLE XVII (*b*)—*Yield of green leaves in ounces.*

Number and treatments.	Mean weight of leaves.
1 Copper sulphate and ferrous sulphate solution.	17·70
2 Copper sulphate solution	16·84
3 Ferrous sulphate solution	16·98
4 Agri tree-killer	17·48
5 Hand-picking every day	20·38
6 Hand-picking every alternate day	18·14
7 Hand-picking once in three days	18·60
8 Hand-picking once a week	18·92
9 Control	16·68

Standard error—2·09.
Significance—Not significant.

Experiment VI—Effect of rotation with crops other than known hosts.—The object of the experiment was to see if the incidence of orobanche on tobacco could be reduced by growing crops which are not liable to be parasitised by orobanche in the interval between two successive crops of tobacco. The experiment was laid out in duplicate, one in the Government farm, Guntur, and the other in a neighbouring ryot's field, in randomised blocks replicated four times.

The treatments were as follows:—

Crop.	First year.	Second year.	Third year.	Fourth year.
I	Tobacco	Tobacco	Tobacco	Tobacco.
II	Pyru jonna	Do.	Pyru jonna	Do.
III	Tobacco	Chillies	Coriander	Do.
IV	Do.	Tobacco	Variga	Do.
V	Groundnut	Do.	Maize	Do.
VI	Chillies	Do.	Sajja	Do.

The crops mentioned are those usually grown in the tracts by ryots in rotation with tobacco. This is the first year of the experiment, and a record of the incidence of the rapes in the plots sown to tobacco showed that the fields chosen for the experiment were representative types of orobanche-infested land.

Experiment VII—Varietal resistance trials.—Twenty-one varieties of tobacco were grown in an orobanche infested soil in order to test their susceptibility to the attack of the parasite. The experiment was laid out in balanced incomplete block arrangement, in twenty-one blocks each made up of 5 varieties.

The growth of the crop was very poor owing to the failure of the rains and incidence of orobanche was also negligible.

Experiment VIII.—Effect of preceding crop on the incidence of orobanche cernua.—In order to ascertain if the intensity of orobanche incidence in a tobacco crop is in any way influenced by the nature of the crop grown in the field in the preceding season, an experiment was laid out in field No. 2 E in the Agricultural Research Station and observations were recorded on the incidence of orobanche. The results show that in so far as broom rape incidence is concerned there is no significant difference between one crop and another, but the effect on yield was significant in the case of *sajja* and red *jonna* as preceding crop, these two excercising a depressing effect on the yield while the other crops tried had no such effect.

TABLE XVIII.— *Incidence of orobanche on tobacco and yield of tobacco influenced by preceding crops.*

Lay out—Randomized blocks.

Replications—4.

Number and treatments.	Mean number of rapes per plot.
1 *Setaria italica* grown in Punasa	22·5
2 *Arachis hypogea* grown in Punasa ..	7·5
3 *Sorghum vulgare* .. .. Red jonna	13·0
4 *Zea Mays*	26·5
5 Sajja	16·5
6 Control	32·0

Standard error—12·69.

Critical difference—27·04.

General mean—19·7.

Not significant.

	Mean yield per plot green weight of leaves in ounce.
1	514·8
2	390·0
3	322·5
4	665·0
5	338·3
6	666·8

General mean—482·9.
Standard error—13·4.
Critical difference—85·77.
Significant or not—Significant.

Conclusion—

No crop.	Maize.	Korra.	Groundnut.	Sajja.	Red jonna.
666·8	665·0	514·8	390·0	338·3	322·5

13. *Fundamental studies on tobacco 'broom rape'*—(1) *Longevity of orobanche seed.*—Seeds collected one year and six months previous to the date of experiment were found to be viable.

(2) *Role of domestic animals feeding on the parasite in disseminating the infection.*—Buffaloes, cattle and goats feed on orobanche shoots, and are believed to be a means of dissemination of the parasite through their dungs. In order to ascertain if the seeds collected from the voids of these animals retain their viability, an experiment was carried out. Buffaloes, oxen (calves) and goats were fed with orobanche shoots with mature seeds, for one day and the dung was collected during seven succeeding days. Dung from each day's collection was mixed with sterilized soil in pots and the pots were planted with tobacco. The incidence of orobanche was recorded for each series. The results indicated that the voids of buffaloes, cattle (calves) and goats contained viable seed, and that the excreta of goats showed the presence of viable seeds till the third day while those of the buffalo and the ox till the fifth day after feeding on orobanche shoots.

(3) *Germination studies.*—Orobanche being a parasite, the presence of a suitable host plant is usually necessary to induce germination of its seed. In connexion with the experiments on this parasite, the necessity has often been felt for a quick and reliable method of inducing germination under laboratory condition, for in testing the viability of seed much labour and time could be saved if a rapid laboratory method of testing the seed is available. With this end in view a series of trials were made and the results are as follows :—

(i) Extracts of leaves, stems and roots of tobacco, sunflower and tomato failed to give positive results.

(ii) Treating the seed with sulphuric acid 5 per cent and 10 per cent and ammonium hydroxide (concentrated) failed to give positive results.

(iii) Successful germination of orobanche was obtained by the following methods :—

(*a*) Portions of tobacco roots dug out from the soil were placed on a clean glass slide and orobanche seed was dusted on the roots. The roots were covered by a second glass slide, the pair tied firmly together and buried in soil which was moistened with water. Germination of seed was observed on the fifth day.

(*b*) Orobanche seed was dusted on both sides of a piece of moistened blotting paper, which was placed between two glass slides and secured at both ends. The slides were buried in the soil in pots in which tobacco seedlings had been planted. Germination of the seed was noticed after nineteen days, though it was observed that the roots of tobacco did not actually come in contact with the seed between the slides.

(iv) *Host range—Pot culture studies.*—The following plants were found to be susceptible of being parasitised by *Orobanche cernua* var *desertorum*, under the conditions of the experiment :—

Solanum xanthocarpum, Solanum trilobatum, Nicotiana rustica, Nicotiana affinis, Nicotiana glutinosa, Helianthus annum, Datura stramonium, Datura fastuosa and *Datura fastuosa* var. *alba, Lycopersicum esculentum* and *Petunia* sp. It was observed in the course of these experiments that *Datura fastuosa* var *alba*, exercised a markedly stimulating effect on orobanche seed inducing germination of large numbers, as many as 300 shoots being observed on a single plant. In an experiment, plants of *Datura fastuosa* var. *alba* and tobacco were planted in the same pot filled with soil infested with orobanche and evidence was obtained that more rapes attached themselves to *Datura* than to tobacco grown in the same pot. The average for *Datura fastuosa* was 107·5 and for tobacco only 26. Trials with other species of *Datura*, viz., *D. stramonium* and *D. fastuosa* (purple variety) and tomato grown with tobacco in the same pots, did not show any marked difference in the intensity of their orobanche infestation when compared with that of tobacco.

Experiments on the control of orobanche utilizing Datura fastuosa as a trap crop.—Experiment 1.—The marked affinity of *Datura fastuosa* var *alba* to orobanche offers a means of utilizing this as a trap crop to reduce the incidence of the parasite. An experiment was laid out during the current season to find out if the method is feasible. The experiment is in progress.

Layout—Randomized blocks replicated 12 times.

Treatments—2.

(1) Growing *Datura* at the earliest period in the *punasa* or early season and transplanting tobacco in the *pyru* (or late) season.

(2) Control. Without *Datura* in the *punasa* season. Transplanting tobacco in *pyru* season.

Experiment 2.—Another experiment is in progress to find out the optimum period of sowing *Datura* with a view to obtaining the germination of maximum number of orobanche seed.

14. *Tobacco 'Damping off' in the nurseries.*—The disease causes considerable damage to seedling, and is a limiting factor in tobacco cultivation in Guntur—

(*a*) *Fundamental studies—Organisms involved.*—The causal organism responsible for damping off of seedlings in Guntur is *Pythium aphanidermatum* in both sandy and black soils.

(*b*) *Field experiments for control of the disease.*—The field experiments mentioned below were carried out in duplicate, one set in a representative sandy area at Bapatla, another in the black soil area of the Agricultural Research Station, Guntur.

Experiment I—Relative efficacy of various treatments.—The object of the experiment was to find out the relative efficacy of treatment with fungicides like bouisol, bordeaux mixture and home-made colloidal copper, and raising the leavel of nursery beds. The experiment was laid out on a split plot randomized design with six replications as per the following scheme :—

Main treatment.															
Raised beds.								Low beds.							
Heat sterilized.				Non-sterilized.				Heat sterilized.				Non-sterilized.			
A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D

NOTE.—A. Bouisol 1 oz. in one gallon of water.
B. Bordeaux mixture one per cent.
C. Home-made colloidal copper, three pints to ten gallons of water.
D. Control.

The fungicides were applied at the rate of five gallons of spray fluid per cent of nursery. The evaluation of the results was based on the number of healthy seedlings available for transplanting per treatment. The disease was not much in evidence in the black cotton soil area, and the treated beds did not show superiority over control ; in the sandy soil area at Bapatla, the disease was rampant during the season and considerable damage was done to the nurseries and it was found that the beds treated with 1 per cent bordeaux mixture were markedly superior to other treatments and the number of seedlings in these beds were nearly five times that in the control beds.

The results are as follows :—

TABLE XIX.—*Mean number of surviving seedlings per plot under various treatments for the control of damping off.*

Treatments.	Raised.				Low.			
Sub-treatments.	Control.	Bouisol.	Colloidal copper.	Bordeaux mixture.	Control.	Bouisol.	Colloidal copper.	Bordeaux mixture.
Sterilized ..	37·0	37·5	76·3	340·0	111·7	84·3	283·2	399·8
Mean ..		122·7				219·8		

Standard error—37·9.
Critical difference—97·4.
Not significant.

Treatments.	Raised.				Low.			
sub-treatments.	Control.	Bouisol.	Colloidal copper.	Bordeaux mixture.	Control	Bouisol.	Colloidal Copper.	Bordeaux mixture.
Non-sterilized.	88·8	129·2	107·2	238·8	70·0	40·8	159·0	431·3
Mean ..		141·0				175·3		
Non-sterilized.	62·9	83·9	91·8	289·4	90·9	62·6	227·1	415·6
Mean ..		132·0				197·6		

There is no significant difference between raised and low beds.

TABLE XX.

Treatment.	Control.	Bouisol.	Colloidal copper.	Bordeaux mixture.	Mean.
Sterilized	74·4	60·9	179·8	369·9	171·3
Non-sterilized	79·4	85·0	133·1	335·1	158·2
Mean	76·9	72·95	156·45	352·5	..

The difference between sterilized and non-sterilized plots was not significant. The results of comparison between the sub-plot treatments were highly significant. Standard error 41·9 ; Critical difference 83·96.

Conclusion—

Control.	Bouisol.	Colloidal copper.	Bordeaux mixture.
76·9	72·95	156·45	352·5

(1) Bordeaux mixture has been very effective in controlling damping off and there is no significant difference between the other treatments and control.

(2) The interaction between level of beds and sterilization between level of the beds and the fungicides, between sterilization and fungicides and among these three are not significant

Economics of spraying.—Based on the above experiment, the economics of the various fungicidal treatments are as shown under :—

	RS.
Cost of spraying one acre with 1 per cent Bordeaux mixture at the rate of 1,500 gallons for three sprayings, the price of copper sulphate being calculated at Rs. 70 per cwt.	98
Cost of spraying one acre of seedling with colloidal copper at the same rate	109
Cost of spraying one acre of seedlings with bouisol ..	318

The increased yield of seedlings in the B. mixture treated plots was about five times that of the yield in control plots. The expenses incurred in spraying are more than compensated by the gain due on increased yield.

15. *Diseases of oilseed crops*—(1) *Groundnut* (Tikka) *Cercospora personata and C. arachidicola.*—Field experiments conducted at

Tindivanam in collaboration with the Oil Seeds Specialist showed that *Tikka* disease is controllable by the application of bordeaux mixture of 1 per cent and half per cent strength or dusting with finely ground sulphur. In all the treatments the additional yield obtained from the adoption of control measures exceeded the investment on the treatments themselves.

(2) *Gingelly 'sterility'*.—Previous work indicated that the sterility disease is of virus origin. Three cases of successful transmission were obtained with the jassid *Euttetix phycitis* as vector. Grafting experiments were not successful owing to the failure of union between healthy and diseased plants.

16. *Sugarcane mosaic—Varietal resistance—Field experiments.*—This experiment was continued on the same lines as in previous years. The varieties to be tested were grown interstripped between rows of cane raised from mosaic infected setts, and the percentage of diseased clumps in the tested varieties at the end of the experiment was taken as a basis for the evaluation of resistance.

TABLE XXI.—*Percentage of infection in varieties of cane.*

Name of variety.	Percentage of infection.
Co. 213 (control)	48·7
Co. 341	20·0
Co. 349	12·0
Co. 370	26·0
Co. 387	34·0
Co. 395	2·0
Co. 453	Nil.
POJ. 2961	2·0
B. 3013	9·12
M. 1237	8·0
C.O.K. 26	2·0
H.M. 66	22·8

Infection varied from nil to 49 per cent. The control variety Co. 213 showed the highest percentage of infection, while Co. 453 was completely free. Three varieties Co. 395, POJ. 2961 and Co.K. 26 were found to be highly resistant showing only 2 per cent infection under the conditions of the experiment.

17. *Ginger 'soft' rot and 'storage' rot.*—The investigation of these diseases was continued. Previous results have shown that storage rot could be effectively checked by steeping the rhizomes in 1 per cent solution of mercuric chloride, or treatment with fungicides like ceresan and Agrosan G at the rate of 2 grams per pound of rhizome. In an experiment carried out during the year, eighteen treatments involving the use of six fungicides, before storage, before planting and both before storage and before planting were tried to assess their relative merits in the control of storage rot of seed rhizomes and the soft rot of the crop in the field. The results of the storage experiment

showed that the quantity of healthy seed rhizomes recovered was greater under treatments with mercuric chloride, Agrosan G and Ceresan.

TABLE XXII.—*Percentage of healthy rhizomes recovered.*

Treatments.	Percentage of healthy rhizomes recovered.
Mercuric chloride 0·1 per cent for 1½ hours.	72·5
Agrosan G 0·25 per cent for ½ hour ..	81·0
Ceresan (dry) 0·25 per cent for ½ hour ..	75·0
N.G. 3399/9 N 0·25 per cent for ½ hour ..	74·0 *
Ceresan (wet) 0·1 per cent for ½ hour ..	68·0 *
Bouisol 0·35 per cent for ½ hour	59·0 *
Control	64·0 *

* Badly infested with scale insects.

In the field experiment the results showed that the two treatments done before storage and before planting with Agrosan G, mercuric chloride or ceresan (dry) have been better yields than other treatments. When a single treatment is done, treatment with Agrosan G or mercuric chloride before storage is better than treatment before planting.

TABLE XXIII.—*Yield of ginger under different fungicidal treatments of rhizomes.*

Number and treatments.	Mean yield in ounces.
1 A Mercuric chloride before pitting	149·5
2 B Do. planting	98·0
3 C Do. pitting and planting.	137·5
4 D Agrosan G before pitting	132·5
5 E Do. planting	126·0
6 F Do. pitting and planting ..	134·0
7 G Ceresan (dry) before pitting	108·0
8 H Do. planting	127·0
9 I Do. pitting and planting ..	134·0
10 J N.G. 3399/9 N before pitting	124·0
11 K Do. planting	129·0
12 L Do. pitting and planting ..	109·5
13 M Ceresan (wet) before pitting	107·5
14 N Do. planting	104·5
15 O Do. pitting and planting ..	111·5
16 P Bouisol before pitting	129·5
17 Q Do. planting	90·0
18 R Do. pitting and planting	111·0
19 S Control	101·0

Results—Significant.

Summary—Standard error—10·09.

Critical difference—28·67.

Locality—Taliparamba Agricultural Research Station.

Variety—Ernad.

Layout—Randomized block.

Replications—4.

Date of planting—27th May 1943.

Date of harvest—19th January 1944.

Conclusion—

A C F I D P K H E J O R L C M N S B Q

18. *Cardamoms 'clump rot' Pythium spp.*—Clump rot was found to be existent in several discontinuously distributed cardamom tracts. It was equally severe in the erect and creeping panicled types. Two species of *Pythium* were associated with the disease, viz., *P. aphanidermatum and P. complectens.*

III. War Efforts and Agro-industries.

19. *Ergot 'The war and-peace time drug'*—(1) *Research*—(*a*) *Optimum period for sowing rye and injection of flowers.*—To find out the optimum period for sowing rye, an experiment was laid out at the Nanjanad Agricultural Research Station. One cent plots were sown with rye in the first week of every month, irrespective of weather conditions, and uniform sprays were given when the flowers were ready for injection. The results showed that April, May and June were the best months for sowing the rye on the western slopes of the Nilgiris for ergot production, though rye can be grown successfully throughout the year.

TABLE XXIV.—*Yield of ergot on rye grown in different months.*

Month of sowing.	Yield of ergot (dried in the sun) in ounces.	Remarks.
1943—		
April	7	Fusarium was present on the sclerotia.
May	8	
June	7	
July	5	There was rat damage in the plots.
August	4	Do.
September ..	3½	
October	½	Several sclerotia were destroyed by cerebella.
November ..	½	Do.
December		Picking not completed. Do.

Month of sowing.	Yield of ergot (dried in the sun) in ounces.	Remarks.
1944—		
January		Picking not completed.
February		Sprayings in progress.
March		Do.
April		Do.
May		Not yet sprayed.
June		Do.

In another experiment sowings were made every week during the months of April, May, September and October in order to note whether sowing during particular weeks in these months will have any influence on ergot production. The results showed that sowings done in April and May gave better yields of ergot than September and October, but there was no significant difference between one weekly sowing and another during these respective periods.

TABLE XXV.—*Yield of ergot on rye in relation to weekly sowings during the months of April, May, September and October.*

Date of sowing.	Weight of dry ergot in ounces.	Date of sowing.	Weight of dry ergot in ounces.
13th April 1943 ..	5½	3rd September 1943	4¾
19th April 1943 ..	6½	11th September 1943	2-3/8
26th April 1943 ..	5	20th September 1943	2-1/8
4th May 1943 ..	4½	28th September 1943	2
11th May 1943 ..	6	6th October 1943	1⅛
18th May 1943 ..	6¾	13th October 1943	1½
25th May 1943 ..	6¼	22nd October 1943	3

(*b*) *Optimum period and time of the day for inoculation sprays.*—This experiment was carried out in two series. In one serie the inoculation spray was given one week, two weeks and three weeks respectively, after the emergence of earheads. In another series sprays were given at 10 a.m., 3 p.m. and 8 p.m., respectively. It was found that the best period of spray was the third week after emergence of ears which synchronized with the maximum anthesis. Sprays at different times of the day did not give any significant difference.

TABLE XXVI.—*Yield of ergot on rye sprayed at different times of the day.*

Time of spraying.	Weight of ergot.	Percentage of infection.
	oz.	
10 a.m.	1¼	65
3 p.m.	1¼	65
8 p.m.	1¾	70

TABLE XXVII.—*Yield of ergot on rye sprayed one, two and three weeks after emergence of earhead.*

Time of spraying.	Weight of ergot.
	oz.
One week after emergence	$\frac{1}{4}$
Two weeks do.	1
Three weeks do.	$1\frac{3}{4}$

(*c*) *Optimum number of sprays to produce maximum infection.*—Two series of experiments were conducted using two, four, six and eight sprays per treatment to determine the optimum number of sprays required for maximum infection. In both series 2 sprays gave the lowest yield. In the first series 4, 6 and 8 sprays gave almost uniform yields while in the second series 6 and 8 sprays gave better yield than four sprays.

TABLE XXVIII.—*Yield of ergot in relation to number of sprays.*

Series.	Number of sprays.	Percentage of infection.
I	2	59
	4	68
	6	67
	8	69
II	2	57
	4	66
	6	73
	8	73·5

(*d*) *Varietal trials.*—Eleven varieties of rye including the local rye and Australian Black Winter rye were tried under identical conditions for their susceptibility to infection by *Claviceps purpurea*. All varieties proved susceptible but only the local and Australian Black Winter rye proved suitable for commercial ergot production. Black Winter rye came to maturity in $5\frac{1}{2}$ to 6 months against $6\frac{1}{2}$ months' duration of the local rye but the product of the local rye was superior in alkaloid contents.

(*e*) *Inoculation studies.*—*Claviceps purpurea* was inoculated on oats, barley, wheat, samai, korali and 17 species of grasses. Two cases of successful infection were obtained out of 350 wheat plants inoculated. The other plants did not take infection.

(*f*) *Natural ergot in South India.*—A survey of ergot fungi on grasses was made in the Nilgiris, Pulneys, Wynaad and Anamalais. Nineteen grasses were discovered as affected by species of *Claviceps* but only a few of them produced the sclerotial stage, the rest showing sphacelial stage only.

(*g*) *Rainfall in relation to infection.*—A study of the rainfall records showed a positive correlation between the number of rainy days during the flowering months and the yield of ergot.

(2) *Commercial production of ergot.*—Twenty acres were put under rye during the months of April, May and June 1943. The crop came into flower in 2½ months and flowering continued for one month. Spore suspensions were sprayed on the earheads after the commencement of flower opening. Infection was noticed by the end of July. A yield of 367 lb. of dried ergot was contained. In October and November another 10 acres were put under rye and an yield of 154½ lb. of clean dry ergot was obtained. In April 1944, in pursuance of the special scheme sanctioned for large-scale production of ergot, 54 acres were sown with rye on lands secured from ryots on the basis of a subvention as formulated in the scheme.

20. *Yeast—Researches on conditions for optimum production*—(*a*) *Rate of consumption of sugar in the wort.*—The estimation of sugar content of the wort determined at hourly intervals after the start of fermentation showed that sugars were consumed more rapidly during the second and third hours than at any other period, and the need for additional charges of sugar at this period.

(*b*) *Change of pH in the wort.*—Estimation of pH values of the wort at intervals showed a progressive fall from about 6·1 to about 3·9 within 8 hours.

(*c*) *Rate of consumption of nitrogen.*—The nitrogen content of the medium was estimated at intervals. An accumulation of nitrogen was noticed towards the later stages of the fermentation, particularly at the close. The complete stoppage of liquor ammonia to neutralise the acids produced during fermentation did not materially affect the yield of yeast.

(*d*) *Effect of increased aeration of wort on production.*—The average quantity of dry yeast produced by the use of a diaphram blower of 1·6 c.ft capacity per minute is 1 lb. 1 oz representing 9 per cent of the sugar supplied. By the use of an additional smaller blower of about 0·6 c.ft. capacity an average yield of 1 lb. and 3 oz. were obtained representing 10 per cent of the sugar supplied, thus showing the possibilities of increased aeration.

(*e*) *Effect of the height of the column of wort on production.*—An attempt was made to compare the results of aeration of the same quantity of wort through a column 8 feet in height as against a column 3½ feet in height. This work is in progress.

(*f*) *Cane juice as a source of sugar for yeast production.*—Autoclaved cane juice containing 15 per cent of total sugars was diluted and used as wort. Other conditions being equal, the output was only 4 per cent on sugar. The addition of molasses to cane juice increased the yield to 9 per cent of sugars supplied, thus proving the value of a certain proportion of glucose in the wort and the superiority of molasses as a cheaper source of sugar for yeast production.

(*g*) *Filtration of air for preventing contamination of the product.*—Filtration of air to collect particles of dust and spores of

air-borne organisms was found a prime necessity to prevent contamination of the yeast and to reduce the insoluble ash in the final product.

(*h*) *Control of bacterial contamination.*—The use of sodium metabisulphite at the rate of 1 ounce per 50 gallons of water (1 in 8,000) was found to be effective in preventing bacterial growth without affecting the growth of yeast.

(*i*) *Silvered sand for sterilizing the wort.*—A preliminary study of the use of silvered sand which is reputed for its oligo-dynamic property, showed the possibility of utilizing this material for sterilizing water and sugar solutions without recourse to heat.

(*j*) *Isolation of a large celled strain of Torulopsis utilis.*—A large-celled strain was isolated, multiplied and used for production. While the output per day with this strain was not perceptibly higher than the normal strain, the product was richer in thiamin value but lower in nicotinic acid. There was no perceptible change in flavour.

(*k*) *Quality of the product.*—Samples of the product were analysed by the Government Agricultural Chemist and the vitamin contents assayed by the Director, Nutrition Research Laboratories, Coonoor, and the Controller-General of Food Supplies, New Delhi. The reports were highly complimentary.

Quantity produced.—A total quantity of 150 lb. of dry yeast was prepared during the year and 106 lb. sold to the public directly or through the Government Products Sales Depot, Madras.

(*l*) *Baker's yeast.*—A strain of *Saccharomyces cerevisiae* was multiplied and the usefulness as Baker's yeast tested satisfactorily. Small samples were supplied on indent.

21. *Malt extract—Control of mouldiness in storage.*—(*a*) *Source of contamination.*—This was found to be through air-borne spores between the drawing of the extract from the still and final packing and storage. The organisms involved are *Aspergillus* sp., *Rhizopus* sp. yeasts and bacteria. The fungi being aerobic organisms grow only on the surface.

(*b*) *Control measures*—(1) *Sterilization by heat.*—The thermal death point of *Aspergillus* sp. was found to be 75°C for thick walled spores and 55° C for thin walled spores, and of yeast and bacteria 85° C for ten minutes exposure. Steaming the product for two hours daily for two consecutive days was found to be effective in rendering it completely free from viable organisms, but the process adversely affected the taste and flavour of the extract besides inducing frothing.

(2) *The use of preservatives.*—Experiments were carried out to find out if the addition of the following would be effective in controlling moulds in the extract: (1) Thymol 1 in 1000 aqueous solution, (2) boric acid 1 per cent aqueous solution, (3) salycylic acid 1 per cent aqueous solution, (4) chloroform pure, (5) formalin

40 per cent, (6) alcohol 95 per cent and (7) glycerine added as a thin layer on the top. Of these, boric acid, thymol and salycylic acid were found to be ineffective, chloroform while effective was not to be recommended owing to its poisonous nature. Formalin, alcohol and glycerine were effective and further experiments are in progress to find out the extent to which the use of these can be incorporated in practice.

(3) *Increase of the concentration of extract.*—Experiments carried out in collaboration with the Government Agricutural Chemist gave results which indicated that with the increase of the density of the extract, the development of fungus is inhibited.

22. *Grow More Food*—(*a*) *Sorghum 'Anti-smut' campaign.*—With a view to obviate the losses from the smut disease of sorghum and thus increase the production of foodgrains in the Province, a scheme was drawn up to popularise the use of sulphur as a seed dressing for sorghum seeds. Sanction was obtained for the purchase and distribution of 42 tons of ground sulphur which is about 15 times the quantity of sulphur used for the purpose in normal years. When put into operation, the production of sorghum in the Province is expected to increase by at least 10 per cent.

(*b*) *Control of pests and diseases of food crops.*—A scheme to provide relief against the preventable and controllable pests and diseases of vegetables and other food crops was formulated. In the absence of standard spraying equipment, the question of purchasing all the A.R.P. stirrup pumps, converting them into spraying equipment with the least expenditure and distributing them throughout the Province was studied and preliminary proposals submitted to the Director of Agriculture.

(*c*) *Edible mushroom.*—The feasibility of growing edible mushroom from waste paddy straw was studied, the method of cultivation perfected and demonstrations conducted in Coimbatore, Tirurkuppam and Madras. Battles of mushroom spawn were supplied on indent.

23. *Agri tree-killer.*—Due to the cessation of imports of proprietory tree killer solutions, a substitute mixture called 'Agri tree-killer' was prepared from ingredients available in India and 34 gallons were distributed to Devasthanams and other clients.

24. *Penicillin.*—Cultures of *Peni illium notatum* were obtained and preliminary studies made on the production of this valuable antiseptic under South Indian conditions.

25. *Potato—Production, conservation and distribution.*—I was privilaged to study the system of production, conservation and distribution of potatoes grown in the Bombay Province at Poona and neighbouring centres and to submit a report on the system in vogue in that Province. As a sequel to this report, I prepared and submitted a scheme for the conservation and distribution of potatoes grown in the Madras Province.

IV. Plant Quarantine—Legislative Measures.

26. The examination and certification of exports of plants and plant products continued during the year.

The Madras Agricultural Pests and Diseases Act continued to be administered in the Province in respect of the following diseases :—

(1) *Budrot of palmyra and coconut palms.*—The Act was enforced in respect of this disease in the districts of West Godavari, East Godavari, Krishna and parts of Guntur and Malabar districts—

(*a*) *West Godavari.*—A special staff consisting of one Special Tahsildar, one clerk, four Special Revenue Inspectors, 12 maistris and six peons were engaged throughout the year. A field Inspector, a supervisor and nine maistris employed by Messrs. Parry & Co., aided the special staff in Kovur, Tanuku and Narasapur taluks. The co-operation of the village officers was not much in evidence.

(*b*) *Krishna.*—The special staff engaged in the work consisted of 3 Revenue Inspectors, 3 peons and 2 maistris.

(*c*) *East Godavari.*—The special staff consisting of 11 Revenue Inspectors, 5 maistris and 11 peons were engaged throughout the year.

(*d*) *Guntur.*—The Act was in force in the Repalle and Tenali taluks of the district. A special Revenue Inspector was in charge of the work.

(*e*) *Malabar.*—The Act was in force in Palghat, Walluvanad and Ponnani taluks of South Malabar. A special staff consisting of one Revenue Inspector and a sub-assistant in Mycology was in charge of the work.

(2) *Wheat rusts.*—The Act was successfully enforced in respect of this disease in the Nilgiri district and the Koda kanal taluk of Mathurai district. The cultivation of wheat and barley was prohibited during the months of April to September in these notified areas and an intensive campaign was carried out to eradicate all stubbles, tillers, and volunteer plants with the aid of the Act. A survey of the wheat crops in different parts of the Presidency was made during the months of November to January in order to gauge the incidence of rust and it was noticed that the disease was in evidence in Coimbatore, Bellary and northern districts of Mysore. In the hills, however, the September sown crop was free from rust till the end of January. A special staff of two Agricultural Demonstrators for six months and one assistant for four months were engaged in this work during the year.

(3) *Broom rape of tobacco.*—The Act was in force in the districts of Guntur, Krishna, East Godavari, West Godavari and Nellore. A special staff of one gazetted officer, one upper subordinate, two clerks, 22 fieldmen and 66 maistris was employed under the Agricultural department for the control of broom rape of tobacco.

(4) *Cardamom mosaic.*—The Act continued to be in force during the year in the Nelliampathies in the Palghat taluk of Malabar district for the specific purpose of preventing the entry of mosaic disease of cardamom into this district which is free from the disease.

(5) *Spike disease of sandal.*—The Act was in force in parts of Salem district.

V. Propaganda.

27. Leaflets and charts were prepared on the following subjects :—

(1) *Mahali* disease of areca palms. A new recipe for spraying.
(2) Sugarcane smut. Its control.
(3) The uses of ergot.
(4) Kill unwanted trees.
(5) The rusts of wheat.

The section participated in several exhibitions and shows. The more important among them were the War Services Exhibition at Madras and the Flower Show at Ootacamund. I gave a talk at the Toc H Services Club, Coimbatore, on the war efforts ofthe Madras Agricultural department.

28. *Teaching.*—Thirty-two theory classes and 31 practical classes were held for the students of B.Sc., III. Besides these, sixteen classes were held for the students of the Short Course in Agricultural Sciences.

29. *Advisory.*—Sixty-nine specimens were examined and reported on besides answering several enquiries by correspondence.

VI. Microtome sub-section.

30. *Microtamy.*—One hundred and one materials were received, 37 imbedded and 617 permanent slides prepared and supplied to various research workers in the department.

VII. Miscellaneous.

31. *Supply of cultures.*—Stock cultures of fungi were supplied to the Imperial Mycologist, the Mycologist to the Government of Central Provinces and Berar, the Economic Botanist, Assam, the Mycologist, Ceylon, the Professor of Botany, Dacca University, the Professor of Botany, Presidency College, Madras, and the Professor of Botany, Agricultural Institute, Allahabad.

Coimbatore,
26th August 1944.

K. M. THOMAS,
Government Mycologist.